Compressed Air Magazine

Engineering Library

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BALSA BOAT ON WORLD'S HIGHEST NAVIGABLE LAKE

How GELAMITE became the Standard Explosive for METAL MINING

AN EXAMPLE OF EXPLOSIVES PROGRESS

1. EXPLOSIVES HISTORY was made in 1929 when Hercules introduced Gelamite—the first semi-gelatin.

2. WITH MORE CARTRIDGES per 100 lbs., Gelamite offered substantial savings over older gelatin types.

3. REPLACING regular gelatin grades, cartridge for cartridge, it gave the same breakage.

4. IN WATER RESISTANCE, Gelamite was found O.K. for practically all mining conditions.

5. ON FUMES, too, Gelamite stacked up with gelatins. Mucking could start with minimum delay.

6. IN UPWARD POINTING holes, miners found it plastic and cohesive like gelatin.

7. METAL MINES were quick to adopt this remarkable explosive; it was specified for many properties.

8 HERCULES RESEARCH has resulted in constant refinements since Gelamite was introduced.

9. IN TEN YEARS Gelamite has come of age. It is now the standard metal mining explosive.

HERCULES POWDER COMPANY
INCORPORATED

932 King Street, Wilmington, Delaware

ON THE COVER

DESPITE its Chineselike appearance, our cover picture was taken in South America. It depicts a native boatman in a craft made of balsa wood, which is lighter than cork. The setting is Lake Titicaca which lies 12,644 feet above sea level. This body of water is located a short distance northwest of La Paz, Bolivia, and is partly in Bolivia and partly in Peru. It is 138 miles long and 69 miles wide.

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IN THIS ISSUE

THE United States uses more paper than any other country, the per capita consumption exceeding 225 pounds a year. Despite its extensive forests, the nation imports large quantities of wood pulp for paper making. The domestic pulp industry is growing rapidly, however, as a result of the large-scale development of southern pine. An acre of southern land will grow a cord of pulpwood a year, and from each cord there can be produced more than a ton of pulp. Labor costs, climate, and other factors are favorable to economical processing. Our leading article tells more of the story of southern pine.

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IT HAS often been said that a bridge is the most beautiful of all engineering works. The graceful lines of the Lions Gate Bridge are the more impressive because of the scenic charm of the structure's setting. The crossing serves a long-felt need for direct communication between Vancouver and its environs on the opposite shore of Burrard Inlet. The placing of the foundations of the piers that support the towers of the 3-span suspension bridge entailed some interesting problems, which are described in our second article.

Compressed Air Magazine

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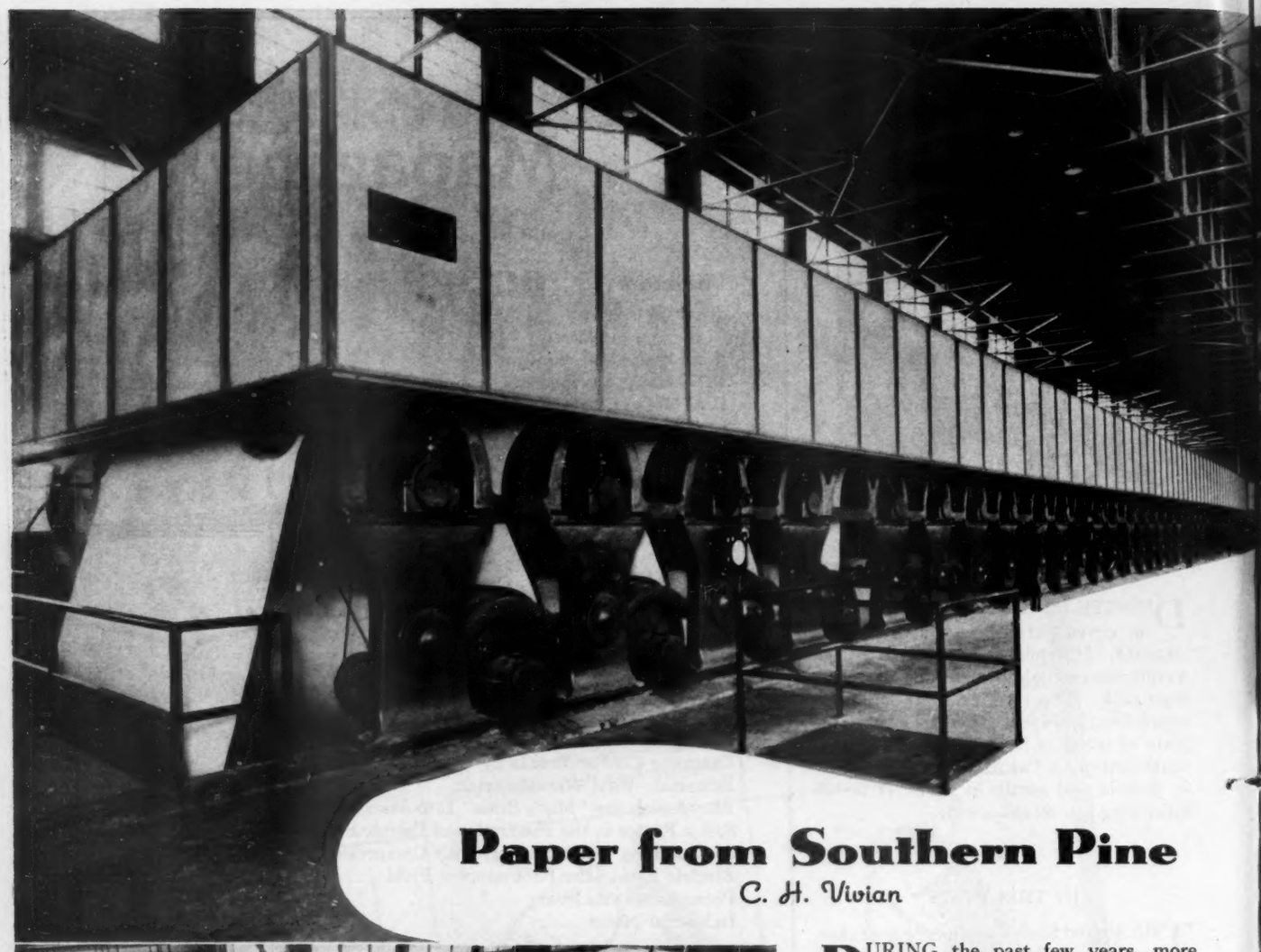
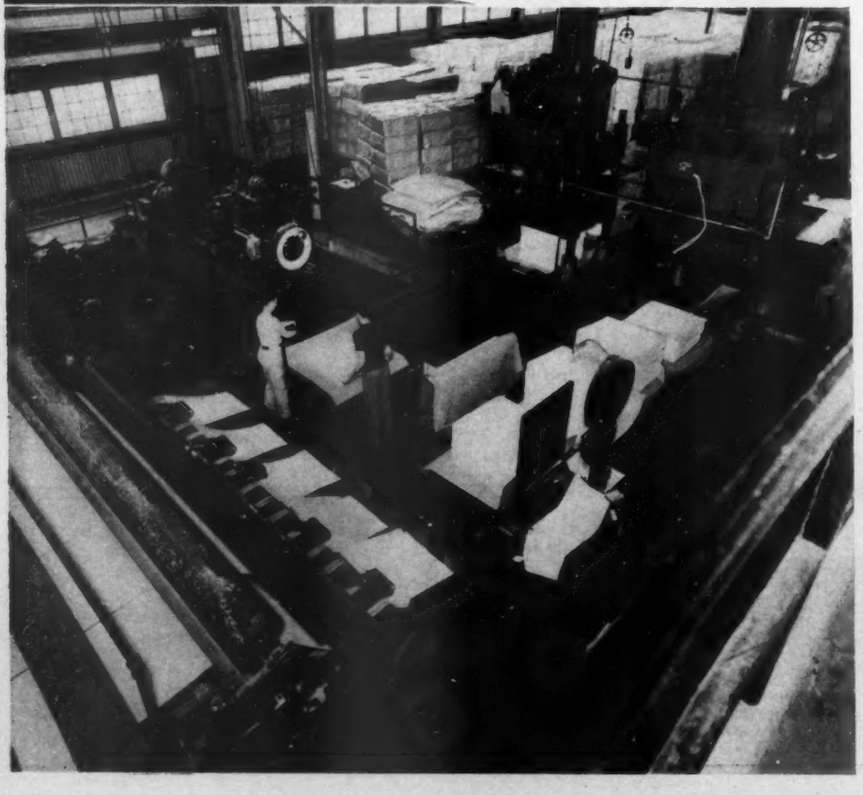


Paper from Southern Pine

C. H. Vivian



DURING the past few years, more than $100,000,000 has been invested in new pulp and paper mills in ten southern states. In 1938, alone, six new plants went into production. They cost $27,000,000. Additional construction aggregating $25,000,000 in value is underway, or will be started before this year ends. At the beginning of 1935, the ten states concerned had 31 mills whose daily capacity was 4,000 tons. By the end of 1938 there were 44 mills, and their combined capacity was 7,600 tons, or a gain of 90 per cent in four years.

The foregoing figures constitute a brief story of a striking industrial migration. At present, approximately one-eighth of the world's production of pulp could be turned out by the facilities available below the Mason and Dixon line. Even so, there seems to be room for all these new mills and for others that are projected, for the nation continues to import large quantities of pulp, and our consumption of paper increases by approximately 500,000 tons annually.

This shifting of the pulp and paper industry is not a new trend, for it has always been confronted with the problem of establishing new plants in following the retreating forests on which it feeds. The nation's

AERIAL VIEW OF MILL

In the center foreground are rotary lime kilns; at their left are the pulp processing and bleaching buildings; and farther left is the finishing building. At the right of the lime kilns is the liquor recovery unit, and back of that may be seen piles of logs in storage. The stretch of water at the upper left is the Houston Ship Canal, which extends to Galveston Bay and gives the Houston industrial area deep-water transportation. One of the many oil refineries in the district is shown at the upper right.

first pulp and paper mills were concentrated in New England, close to both wood and markets. A paper mill cannot be moved readily, so, as the wood supply became scarce, the established plants remained where they were and shipped in their logs or their pulp from greater and greater distances. However, when new mills were erected, they sought locations where timber was plentiful.

About 35 years ago, paper interests of the United States began to build plants in Canada, and since then have invested, all told, some $400,000,000 there. With the gradual spreading out of population in the United States, additional mills were likewise set up in or near various wooded sections in this country, notably around the Great Lakes and in the Northwest. The latter plants can do little more than supply sectional demands, however, for the weight and bulk of paper make freight charges too high to permit shipping it great distances and selling it at competitive prices.

There is something distinctly novel in the large-scale movement to the South. While scattered plants have been operating in that part of the South that lies within easy reach of northern markets, the region as a whole has been shunned by the industry in the belief that its woods were unsuited for paper making. Southern pine contains considerable quantities of turpentine, pitch, fats, and resin, substances that for years confounded the technologists and brought the wood into general disrepute. Thus, despite the fact that a few plants were pulping it satisfactorily, southern pine had little appeal for the industry as a whole.

The late Charles H. Herty, an eminent chemist, is credited with having done more than any other person to change the opinion of the paper industry regarding the despised southern pine. A native of Georgia, he taught chemistry in the South as a young man; and then conducted researches for the Forestry Division of the U. S. Department of Agriculture that resulted in increasing the yield of turpentine from pine trees. After that he went north and spent many years as editor of *Industrial and Engineering Chemistry*. Always, however, he retained a conviction that the southern woods had great industrial potentialities; and when he was past 60 years of age he re-

FINISHING OPERATIONS

A 165-inch-wide sheet of bleached kraft pulp (opposite page, above) at the discharge end of the drying rolls which are connected with the Fourdrinier paper machine on which the cellulose fibers are felted to form a mat. At the beginning of the operation the pulp, carried by 100 to 200 times its volume of water, is fed through a slot on to a traveling screen 166 inches wide and 80 feet long. Excess water drains out, and the pulp moves on to felts that convey it into a press section where additional water is squeezed out. Next, it enters a drier section, consisting of 56 rolls, which are internally heated with steam. The finished pulp contains from 7 to 14 per cent moisture. The pulp goes through this series of finishing operations at a speed of 100 to 250 feet per minute, depending upon the grade and weight of the sheet being made. As the 165-inch-wide sheet comes from the discharge end of the drying rolls, it is slit into five strips, and these are cut into 33x33-inch squares. The two men at the left (lower picture) are shown stacking the sheets on scales at either side until the desired weight of 450 pounds is reached. The piles then move on a roller conveyor to a Baldwin-Southwark hydraulic press, where the sheets are compacted under great pressure. From the press they go to a bailer, where an air-operated ram compresses them while they are being securely bound with metal strips and wrapped in heavy paper. The bales are placed, five at a time, on an industrial truck and loaded into cars on an adjacent siding. Most of the pulp is now shipped to Champion's paper mills at Canton, N. C., and Hamilton, Ohio, where it is blended with other pulps to be made into fine papers. The Southland Paper Mills, Inc., is completing, near Lufkin, Tex., the first newsprint mill in the South. It will produce its own ground-wood pulp, but will buy some bleached sulphate pulp from Champion's Pasadena mill for blending with it. At Pasadena, Champion is now constructing a mill for the manufacture of coated white paper and will, upon its completion, use much of the pulp made there. Peculiarly enough, even though the United States imports wood pulp, some of the Pasadena output is sold outside the country.

BARKING DRUMS

The logs are introduced at the outer ends of two horizontally disposed cylinders (one is in plain view at the left and part of the second one is visible at the right). These drums rotate at a speed of 12 rpm., tumbling the logs and rubbing them against one another, thus removing the bark. To prevent oil from getting on the logs, the drums are water lubricated. They are so arranged that the logs move through them slowly, about twenty minutes being required for their passage. Openings in the slotted sides of the drums allow the pieces of bark to fall through, and a belt carries them to a waste-heat boiler where they are used as fuel. The barked logs are discharged from the two drums at a common central station and are conveyed to an inspection platform (beneath the roof). Any that still have some bark on them are placed on inclined chutes (one of them is seen at the left) and sent back for another trip through one of the drums. Logs that pass inspection travel up the incline at the right to the chipper. As they move through the tunnel section shown, they are thoroughly washed by high-pressure water jets.

turned to Georgia and began the task of awakening paper men to the possibilities of the pine as a paper-making material.

With the backing of others who shared his beliefs, Doctor Herty set up a wood-products laboratory in Savannah, Ga., and there engaged in chemical research that contributed materially to the technique of converting southern pine into suitable pulp for paper. Certain grades of paper had been successfully made from this wood for 25 years; but Doctor Herty set out to convince the world that it would yield a good quality of newsprint—the paper used by newspapers and imported into this country annually to the value of about $175,000,000. He contended that newsprint of satisfactory quality could be made from southern pine at a cost considerably below that at which the Canadian product derived from spruce could be manufactured.

Capitalizing on his flair for creating arresting publicity, Doctor Herty made up some pulp in his laboratory, ran it through a paper machine in Canada, and sent the resultant newsprint to Georgia where eight newspapers used it to print their editions of November 30, 1933. Some Canadian paper technologists maintain that southern-pine newsprint is not strong enough to withstand the speeds of 1,000 to 1,300 feet a minute common in Canadian paper mills and the even higher speeds at which it is often run through newspaper presses. However, it remains for the future to disclose its comparative merits, for thus far only one mill for the making of newsprint has been built in the South, and it is not yet in operation.

The primary reason for the recent rush of pulp and paper mills to the South was the discovery, or rather the realization, that southern pine was suitable for conversion into pulp by the sulphate process. It was hardly a discovery, for, as we have already pointed out, some mills have been successfully operating in the South for a number of years. Lately, however, there have been improvements in the processing technique that have made it easier to eliminate the undesirable elements from the pine. Doctor Herty originated some of these betterments in his laboratory. His most important service, though, was to focus attention of the industry on southern pine, for it was the investigation he invited that caused opinions to be revised and led to the great southward expansion of the pulp and paper industry.

There are two broad classes of pulp: mechanical and chemical. Mechanical pulp is made by grinding wood. It contains the whole log except the bark, and will, by itself, make only a very crude grade of paper. When mixed with a certain amount of chemical pulp, however, it produces satisfactory newsprint and other coarse papers. Chemical pulp, as the name implies, is made by chemically treating the source material to remove the unwanted constituents and to leave the desirable cellulose that forms the base of all good paper. Cellulose, of which cotton is a very pure form, is present in all plant life. It is the principal component of wood, and its fibrous character, together with the ease of extracting and purifying it, makes wood the greatest source of paper-making material. There are two general chemical processes of isolating the cellulose: the acid and the alkaline. The acid process yields sulphite pulp, while the chief alkaline process, and the one with which we are concerned here, produces sulphate pulp.

The sulphate process is a modification of the older soda process. It was introduced in Danzig in 1884 by C. F. Dahl, and almost immediately became popular with Scan-

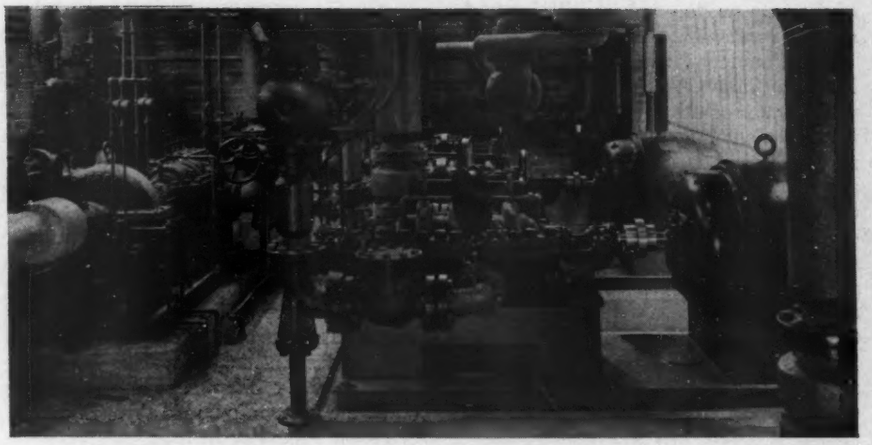
WATER-SUPPLY PUMPS

A mill of the kind described uses more than 200 tons of water for each ton of pulp produced, the total daily water consumption being 15,000,000 to 20,000,000 gallons. At Pasadena, the water is obtained from nine wells and pumped into a 1,500,000-gallon reservoir. One-third of it is reserved for fire-fighting purposes. The three Ingersoll-Rand pumps shown here pump water from the reservoir to the mill. Each has a capacity of 8,000 gpm. against 100 feet of head, and is driven at 1,200 rpm. by a 250-hp. motor. In the same room is an Ingersoll-Rand 200-hp. fire pump with a capacity of 1,500 gpm. against a 290-foot head. It pumps water from the reservoir to a 150-foot-high tower that has a capacity of 100,000 gallons. This tower serves as a standpipe to provide gravity pressure on all fire lines. In addition, there is an emergency-service, 1,500-gpm. pump in the turbine room that draws water direct from the mill supply line.

dinavian paper makers. The product was given the name "Kraft," the German word for strength. Paper consists essentially of a mat of cellulose fibers. The longer the fibers, the better will be the bond between them, and the stronger the paper. The soda process is applicable chiefly to woods from broad-leaved trees such as aspen, poplar, and maple, and as the cellulose fibers in these are short, the resultant paper is not strong. Both the sulphite and sulphate processes are suitable for the pulping of coniferous woods, which have long cellulose fibers and hence produce strong papers. The sulphite treatment is so harsh, however, that it affects the cellulose fibers to some extent and thus somewhat impairs the strength of the paper.

For many years, the bulk of the better-grade papers derived from wood have been made from sulphite pulp, the reason being that the sulphite process produces a sheet of the desired whiteness and one that is smooth and can be given any desired finish. Kraft paper possesses almost all the desirable qualities of the sulphite variety; but it is naturally brown in color, and only of late has it been possible to bleach it satisfactorily. Accordingly, kraft pulp has traditionally been converted into such products as paper bags and wrapping paper, where strength was desired and color was of secondary importance. Even most of the mills that have recently been established in the South are making bags, fiberboard for containers, and similar rough-finished and nonwhite products; but some of them are turning out bleached pulp that is finding its way into fine papers either with or without the addition of other stock.

The antipathy of paper manufacturers to pine was not confined wholly to southern trees, although they were considered even less desirable than those grown in the North. Spruce, hemlock, and fir have always been the most used woods for sulphate pulp. In 1905 only 2 per cent of the country's total consumption of pulpwood was pine. Now it is in excess of 50 per cent.



BOILER FEED PUMPS

These three Ingersoll-Rand NT-4 pumps will each deliver 300 gpm. against a 992-foot head. They operate at 3,500 rpm. Two are driven by motors and the other by a steam turbine.

The sulphate pulp and paper industry was not started in the United States until 1909, or 25 years after its introduction in Europe. At that time two small mills adopted the sulphate process. One was in Roanoke Rapids, N. C., and the other in Muskegon, Mich., and it has not been definitely established which one was the first. Ten years later the country's sulphate-pulp production was 120,400 tons. During the next two decades, 1919-1939, the sulphate industry expanded twenty-five fold, the current facilities being capable of turning out more than 3,000,000 tons of pulp annually. Virtually all this vast increase has taken place in the South. The movement really began about fifteen years ago; but it was halted by the depression and not resumed until recently.

The South offers numerous economic advantages to the pulp and paper industry. It is estimated that it contains 200,000,000 acres of timberlands, with pine the predominating tree. Based on this figure, the region could supply 7,000,000 tons of paper annually, or more than half the 13,000,000 tons that the United States now consumes annually. Because of the favorable climate, trees large enough for pulping can be grown in the South in from 15 to 25 years, whereas equivalent growth in the North requires 40 to 70 years. Furthermore, logging operations can be carried on throughout the year, making it unnecessary to carry large inventories of logs at the mills, as must be done in the North. This reduces capital outlay and prevents considerable loss from rot, insect infestation, etc. Other factors favoring the South are its ample supply of relatively cheap labor and its abundance of water.

Probably the first of the better-known paper companies of the nation to locate in the South was The Champion Paper & Fibre Company. That firm, then the Champion Fibre Company, started operations at Canton, N. C., in 1907, as a manufacturer of sulphite pulp, soda pulp, and chestnut extract. In April, 1919, it opened a sulphate mill designed to produce 50 tons of bleached kraft a day. Since then the capacity of the mill has been increased to 170 tons a day. So far as is known, the Canton mill was the first one in the South to turn out bleached kraft for use in making white paper. On February 16, 1937, Champion opened a new $3,500,000 mill at Pasadena, Tex., near Houston, for the manufacture of bleached kraft pulp from pine. At present the product is being shipped to the company's plants at Canton and Hamilton, Ohio, to be made into paper, and some is also sold in the open market. The Pasadena mill is now being enlarged by the addition of paper-making facilities, and much

AIR COMPRESSORS

These two Ingersoll-Rand machines supply the compressed-air requirements of the mill. They have a combined capacity of approximately 1,500 cfm. at 100 pounds discharge pressure. In the foreground is a 18½&8x10-inch Type XRB unit driven by a 75-hp. motor: the other machine is a 17&10½x12-inch Type XCB driven by a 150-hp. motor. Compressed air is principally used for cleaning and for operating tools used in maintenance work, pressure-regulated valves, and temperature- and pressure-control instruments.

of the pulp produced there will, in the future, be processed on the premises.

The Pasadena plant is situated on the Houston Ship Canal, giving it low-cost water transportation for some of its raw material and its products. An adequate supply of easily accessible timber is available; natural gas for fuel exists in almost unlimited quantities; some of the principal chemicals used are derived from Louisiana salt; and lime is made from oyster shells dredged from the Gulf of Mexico. All in all, the location is a very favorable one from a manufacturing viewpoint.

The principal woods used are shortleaf and loblolly pine. Small quantities of hardwoods also are utilized, but the two are not mixed. Logs are obtained from a radius of 100 miles. Some come from company-owned lands, but most of them are purchased. All are between 6 and 12 inches in diameter, too small to make sawlogs and consequently not wanted by the lumbering industry. In fact, many of the logs are the tops of trees that are discarded by the sawmill loggers of east Texas. Wherever growing trees are cut down to supply logs, at least four trees are left per acre for reseeding purposes.

The logs are cut into uniform lengths of 5 feet before delivery. A cord measure, containing 128 cubic feet, weighs about 6,000 pounds. The logs are transported by truck, train, or barge, and stacked in open storage. The first operation calls for the removal of the bark by tumbling the logs in revolving drums—causing them to rub against one another until the bark is worn away. This requires about twenty minutes. The logs are then conveyed, one at a time, up an incline to the chipper, pausing en route to be washed clean by water jets. Knives on a revolving 96-inch cutter next reduce them to chips approximately 1 inch long, the wood being cut at an angle across the grain so as to expose the maximum amount of surface of the cellulose fiber and thus to facilitate the action of the chemicals in the subsequent processing. The chips are screened, and oversize pieces go back to the chipper.

The chips are elevated to storage, awaiting cooking in the digesters, of which there are six. They are upright, cylindrical, steel vessels, 9½ feet in diameter and 50 feet high. They are unlined, but are insulated on the outside to retain heat. The chips and measured quantities of cooking liquor are introduced at the top. The liquor is drawn off at the bottom, pumped through a bank of steam tubes for heating, and then returned to the digester through the top. Circulation is continued until the desired temperature of 330° to 345°F. prevails in the digester. The pump is then stopped, live steam under 125 pounds pressure is turned into the digester, and cooking continued for several hours.

The purpose of the cooking is to dissolve the lignin, fats, resins, and other undesirable substances so as to leave the cellulose, which constitutes nearly half the wood content. The active ingredients in the liquor are sodium hydrate, or caustic soda, and sodium sulphide. The latter is thought to have little effect on the wood; and as reaction proceeds, much of it is changed into sodium hydrate, which is the more effective agent. However, it is acknowledged that the presence of the sulphide improves the quality of the cellulose fiber and increases the yield.

At the termination of the prescribed cooking period the contents of the digester are "blown" or emptied into a tank, and from there they go to a diffuser or wash room. As a result of the cooking process, the liquid, now called black liquor because of its color, contains all the organic substances dissolved from the wood. It is separated from the cellulose fibers by carefully washing the latter with water heated by waste steam from the digester.

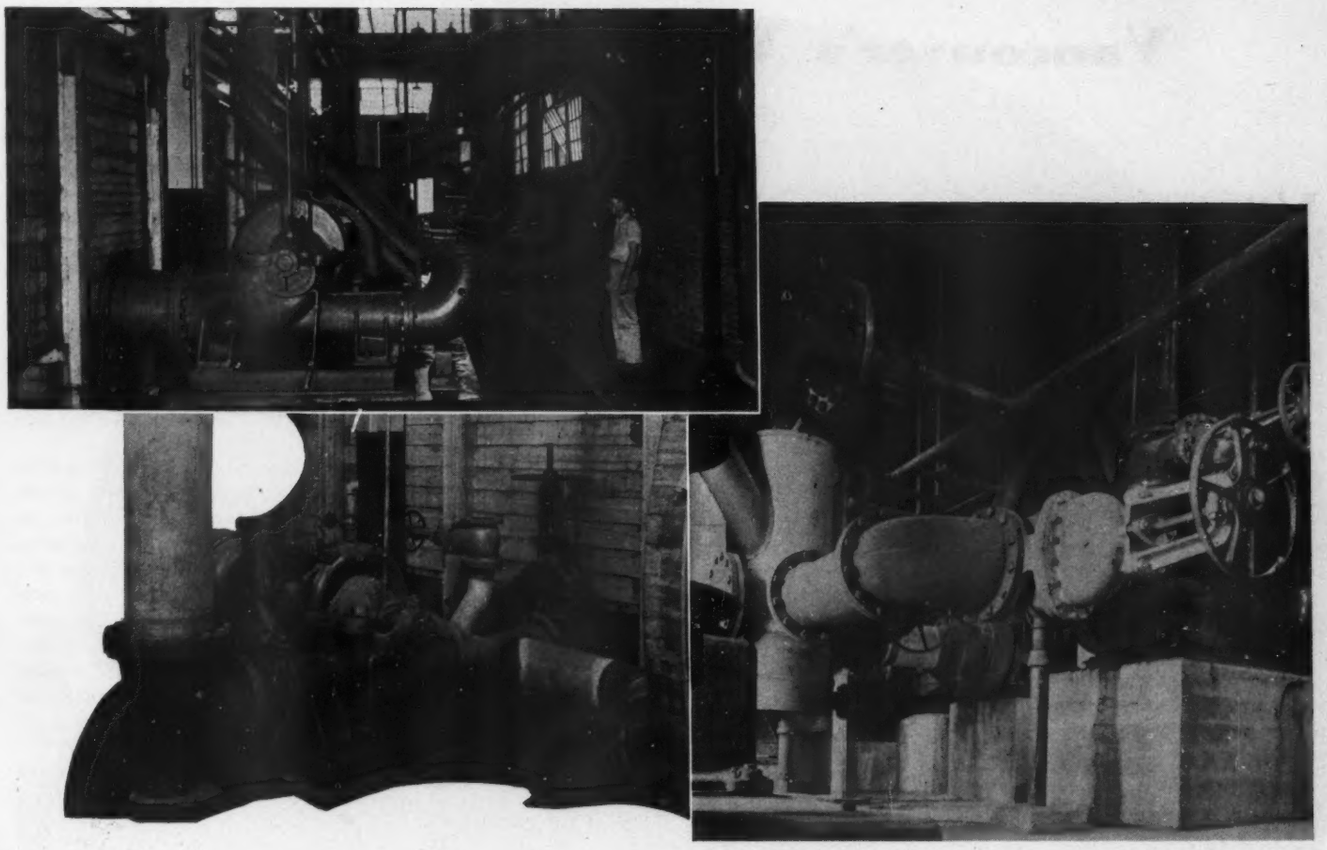
The black liquor is reclaimed for repeated use; and during the process of converting it into its original form, several commercial substances it has extracted from the wood are recovered. As the liquor is greatly diluted by the wash water, the excess water must be removed, and the first step is to partially evaporate it. This produces a semisolid material known as black ash. It contains enough organic matter to sustain combustion, and is burned in a smelter, of which there are four in the plant. At this point there is added to it salt cake—sodium sulphate obtained from either domestic or foreign sources—to restore the chemicals that have been lost during the cooking process. Smelting converts it into a molten mass in which the sodium compounds are largely changed into carbonates. The product drops into a tank where it is dissolved by a sufficient quantity of weak wash water from the liquor room. The resulting liquid is known as green liquor; but it is not suitable for cooking because of its large sodium-carbonate content. Quick lime—calcium oxide—is next added, and in the reaction that takes place sodium hydrate and calcium carbonate are formed. The latter is allowed to settle or removed by filtering, and the remaining liquid, called white liquor, is ready for use in the digesters. The fresh lime that is required is obtained by burning oyster shells in two rotary kilns.

Washing of the cellulose fibers to free them from the cooking liquor is done by stages in rotary-type washers. The residue or cellulose—now pulp—drops into stock chests where it is again diluted to pumping consistency. From there it is pumped to a screen where knots and other coarse materials are separated from the mass and returned to the digesters for further cooking. The accepted pulp then goes to a series of seven plate-type screens consisting of bronze sheets perforated by thousands of narrow slits. From these it is pumped to a thickener where excess water is removed. The thickened pulp next passes through the bleaching plant where the characteristic brown kraft color is changed to white. The bleaching is done in stages, the first reagent being chlorine and the second one sodium hypochlorite. The chlorine is produced by electrolysis of salt brine in airtight cells. Approximately 100,000 cubic feet of hydrogen is obtained every day as a by-product. It is compressed and bottled and sold to manufacturing plants in Houston. Caustic soda—sodium hydroxide—also is derived in the course of the process.

The bleached pulp is diluted and pumped by a rubber-lined pump to a chest in the paper-machine room where it is agitated to aid in washing it. It is then pumped to

EMPLOYEE RECREATION FACILITIES

One end of the 60x100-foot clubhouse which the company maintains as a social center for its 420 employees and their families. A commodious restaurant serves meals and also has tables where lunches brought from home may be eaten. Dances are held in the clubhouse every two weeks during the winter. The company also sponsors various kinds of athletics. The Champion Hospital Association, with employee officers, provides medical and hospital care for employees and members of their families. Safety is the paramount consideration in the mill, and an order by the safety department for the construction of a mechanical safeguard has priority over all other work orders. Last year the mill ran 243,000 man-hours without a disabling or lost-time accident.



STOCK PUMPS

Throughout the processing operations, the pulp is quickly and economically transported by diluting it with from 100 to 400 times its own volume of water and pumping it. Such a mixture of pulp and water is called stock. It can be readily seen that a mill such as the one under consideration calls for a great many pumps, and that they must be highly dependable if service is to be uninterrupted. This group shows three Ingersoll-Rand stock pumps. At the lower left is an AFV unit that handles stock of a quarter of one per cent consistency in the screen room. The screened pulp is then diluted and pumped to a thickener by the ALV unit at the upper left. It has a capacity of 12,000 gpm. against 82 feet of head, and is driven by a 300-hp. synchronous motor. Two of the pumps that transfer stock in the bleaching plant are pictured at the right. They are Class EGV's of 8-inch size.

a flow box for a final washing. From there it flows on to a phosphor-bronze screen where excess water drains out. The screen carries it on to felts which take it through a Fourdrinier-type paper machine at the far end of which it emerges as an endless strip of pulp 165 inches wide and about 1/16 inch thick. This is cut into 33x33-inch squares and baled for shipment.

The rated capacity of the Pasadena mill is 185 tons a day, but the production at times reaches 250 tons. The output depends to some extent upon the degree of bleaching, as additional bleaching both slows up the flow through the plant and also reduces the amount of pulp obtained from each ton of wood. Three grades of pulp are produced, each graded according to its whiteness. Whiteness tests are regularly made in a control laboratory by means of an ingenious machine wherein the amount of light reflected by a sample of pulp is compared with that reflected by opal glass of standard whiteness. This laboratory duplicates in miniature all the regular mill equipment and is really a pilot plant that permits making trial runs with any type of wood to determine the best commercial method of treatment. The laboratory also contains complete apparatus for making all standard tests of pulp and paper.

A mill of this kind consumes from 75,000 to 100,000 gallons of water for each ton of pulp produced, and it must be of good quality. The water is obtained from nine wells, ranging in depths from 500 to 2,000 feet. Some of the well sites are located on the opposite side of the ship channel, and the water may be piped underneath it and to the plant through an 8x10-foot concrete-lined tunnel 808 feet long. The water is treated for slime, algae, etc., and is stored in a 1,500,000-gallon reservoir. One-third of the contents of this reservoir is reserved for fire-fighting. Most of the water is used for washing the pulp at various stages, or for diluting it to facilitate pumping it. Some of it serves more than once. For example, the so-called white water that drains from the pulp as it goes on to the Fourdrinier machine is used farther back in the process for washing purposes. Warm water at two different temperatures is employed in the plant. Mill-supply water (85°F.) that is run through a steam condenser emerges at 140°F., and of this small quantities are used. Most of it is mixed with mill-supply water to provide water at 110° for various washing services.

The Pasadena mill has an unusual arrangement with the Houston Lighting & Power Company whereby it obtains part of its steam supply from the latter's generating station 1.1 miles distant. There is considerable waste heat in the mill. This is obtained by burning bark and from the smelters, and is utilized for firing three boilers totaling 3,170 hp. Additional steam required is delivered by a 14-inch insulated pipe line from the power station. The combined flow, at 350 pounds pressure, is run through two General Electric turbo-generators, one of 5,000-kw. and the other of 4,000-kw. capacity. One operates condensing and the other noncondensing. Both are of the bleeder type, and provision is made for extracting steam at 330, 107, and 35 pounds pressure for various uses in the mill. Condensate is sold to the power company.

In addition to the hydrogen already mentioned, the mill derives several commercial by-products during the pulping process. Turpentine, in which southern pine is rich, comes off during the cooking of the pulp. It is refined in three stills and sold. Trostal, a fatty resinous substance, is obtained during the separation of the pulp and the black liquor. Other commercial by-products are caustic soda and sodium resinate.

Vancouver's Water Gate Bridged

R. G. Skerrett

VANCOUVER, British Columbia, is variously called Canada's Pacific Metropolis or Gateway to the Orient —each appropriate and for different reasons. But to the historically minded, Vancouver is notable because it has grown in less than six decades from a sawmill town of 1,000 inhabitants to the Dominion's third largest city. Together with its suburbs, constituting Greater Vancouver, it has a population of 360,000 of which 270,000 live within the city proper.

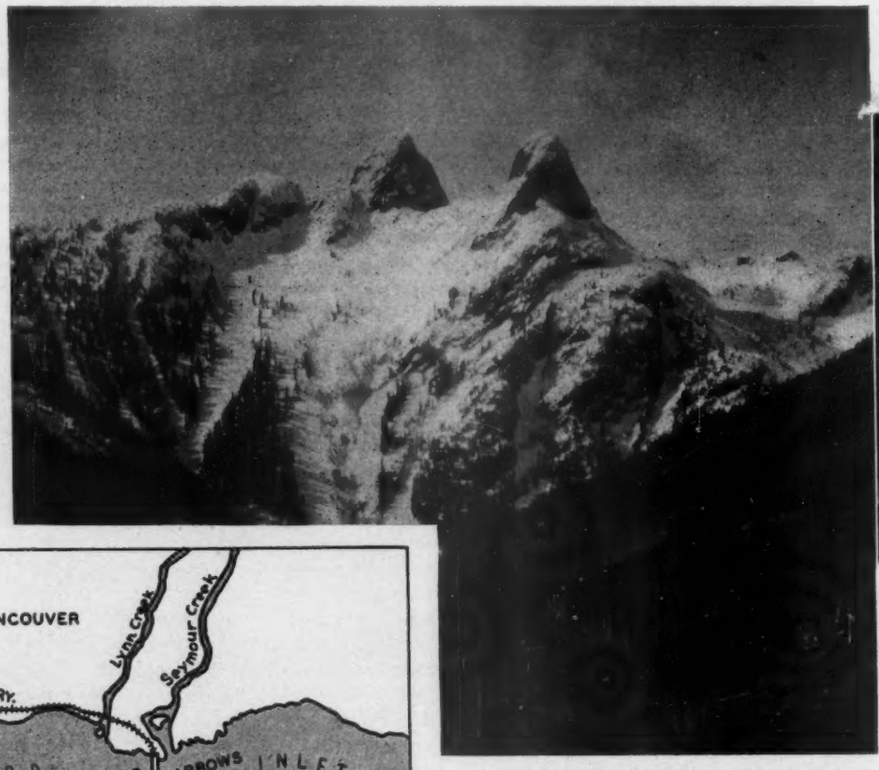
Vancouver is the outlet to the sea for a vast hinterland having tremendous natural riches and great and varied agricultural productiveness. It is said to be the world's chief grain port; and its position in maritime commerce can be gathered from the fact that it is the port of call for more than 50 established steamship lines that reach the principal seaports of the world, not to mention other lines that ply between important points along the Pacific seaboard. Notwithstanding its northerly position, Vancouver has an open port the year round, its climate being a mild one because of the influence of the Japan current. The virtually land-locked harbor has exceptional physical advantages, even though it is situated some 150 miles inland by water from the open ocean. Further, it has become a center of numerous industrial activities; and one American and two Canadian transcontinental railroads terminate there.

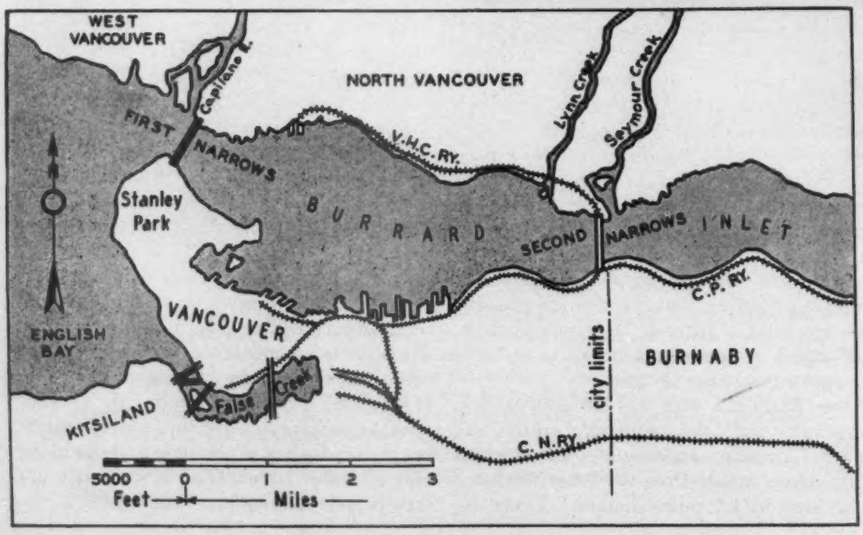
The City of Vancouver is located on the southern shore of Burrard Inlet, and on the opposite side are North Vancouver and West Vancouver, the latter just outside the inner harbor limits. Burrard Inlet is 10 miles long and has a maximum width between Vancouver and North Vancouver of 2.5 miles. At its portal, the inlet is approximately ½ mile wide and is known as the First Narrows. About midlength of the inlet the shores again approach each other, and that passage is called the Second Narrows. Between the two narrows are most of the port facilities, which are diversified and ample in size and capacity to meet all requirements. The grain elevators can store 17,843,000 bushels. Space remains for further extensive development to meet future demands.

Some years ago the Second Narrows was bridged to accommodate a transfer railway system, and was provided with a roadway that is wide enough for only a single lane of vehicular traffic in each direction. More direct passage for vehicles and passengers is afforded by two ferry lines running across the inlet where it is widest. That service repeatedly proved inadequate at peak periods; and weather conditions at times disrupted the schedules. Recurrently, there was popular clamor for a bridge across the First Narrows to promote intercourse between the shores and to aid in the upbuilding of the desirable and unusually picturesque north shore. Nothing materialized, however, to relieve the situation until the First Narrows Bridge Company was organized and money obtained by it to erect the structure that is known as the Lions Gate Bridge.

Work was begun in April, 1937; and so well coördinated were the efforts of the various organizations concerned that the structure, still lacking some finishing touches, was opened to traffic during November, 1938. The official dedication ceremonies took place last summer. The crossing spans the water gap between Stanley Park, within the municipal limits of Vancouver, and the delta of the Capilano River.

Canadian National Railways Photo





THE LIONS

These rock formations, which rise from the top of Hollyburn Ridge, West Vancouver, were the inspiration for the name of the new bridge. At the left is a map of Vancouver and its environs, showing the position of the Lions Gate Bridge that now spans the First Narrows at the portal of Burrard Inlet. An earlier bridge, across the Second Narrows, carries a transfer railroad system and a single lane of vehicular traffic in each direction.

Leonard Frank Photo

THE COMPLETED BRIDGE

This picture adequately portrays the beauty of the structure and of its setting. The photograph was taken from Stanley Park. West Vancouver and North Vancouver lie on the opposite shore. The bridge proper is 2,778 feet long, and consists of two 614-foot side spans and a central 1,550-foot span suspended from towers that rise 383 feet above extreme high water. The lions at the entrance are emblematic of the name Lions Gate Bridge.

on the north shore. It is a suspension bridge made up of a central span, 1,550 feet long, and of two side spans, each 614 feet long. At extreme high water the main span has a clearance of approximately 210 feet for a longitudinal distance of 200 feet, providing ample headroom for any of the ships using the port. The south span takes off from a point in Stanley Park where it rises 150 feet above maximum high water. The north span, because of the low level of that shore, is linked to a descending viaduct 2,196.5 feet long. This, in turn, adjoins a gravel embankment, 1,023 feet long, that terminates at the famous Marine Drive where an overhead crossing and ramps take care of traffic moving to and from the ground level or traveling on the highways that lead inland. The steelwork of the bridge and of the viaduct has a total length of 4,974.5 feet.

The southern approach to the bridge is by way of a new road, 30 feet wide and more than a mile long, that traces a sweeping curve through the towering timber of Stanley Park and connects with one of the principal thoroughfares of the city. The crossing has a natural setting of rare scenic beauty, and one of the problems of the builders was to design a structure that would harmonize with that environment. In this they have been eminently successful. Twin rock formations at the top of a mountain overlooking the First Narrows from the north and popularly known as The Lions suggested the name chosen for the bridge. It has a 3-lane roadway that is 29 feet 4 inches wide between curbs, and there is a 4-foot walk at each side. It is a toll

Canadian Pacific Railway Photo

VANCOUVER WATERFRONT

This picture shows the widest part of Burrard Inlet, which is 10 miles long. Vancouver is reputed to be the world's largest grain port, and its harbor is one of the finest in existence. The city and its suburbs have a population of 360,000. More than 50 established steamship lines and three transcontinental railroads serve the port.

bridge; and by the terms of the franchise under which it has been constructed, the City of Vancouver may acquire it after 50 years by paying the value of the structure at that time.

The deck system is hung from two continuous cables, each about 3,400 feet long, that are carried over two steel towers which rise 365 feet above the tops of the supporting reinforced-concrete piers. The latter reach 17.73 feet above extreme high water, and their foundations are set at different depths because of the dissimilarity of the geological formations on which they rest. The same may be said of the cable anchorages. Each cable has an over-all diameter of 13¼ inches and consists of 61 strands each 1 7/16 inches in diameter. The wire was furnished by the John A. Roebling's Sons Company, and the strands, each of which is composed of 47 wires, were made up by the Anglo-Canadian Wire Rope Company. The strands were prestressed, marked, and socketed by the Dominion Bridge Company at Longueuil, Que., and shipped on wooden reels to the building site.

The suspender ropes, which connect the deck system with the main cables, are each 1¾ inches in diameter and were fabricated of wire the same as that used for the main cables. The latter are 40 feet apart, and the longitudinal stiffening trusses of the deck system also are 40 feet apart on centers. The trusses have a depth of 15 feet; and between them are placed the crossbeams and stringers that form the basic structure for the roadway and the two sidewalks. The pavements of both roadway and sidewalks are made up of tee grids filled with concrete, thus providing essential reinforcing and a good wearing surface.

The two main towers are built of steel plates and angles and are stiffened internally by a succession of diaphragms. Externally the two legs of each of these structures are tied together and braced by a system of struts and diagonals that assure the necessary resistance to lateral stresses. The interior of each tower is electrically lighted and equipped with ladders; but, eventually, electric elevators may be installed. The structures are surmounted by finials, that give a pleasing architectural finish, and carry aviation beacons. At the foot of each tower there is an 18-ton structural base that is cruciform in plan and measures about 22x12x2½ feet. This is anchored to the masonry pier by heavy bolts deeply embedded in concrete and to the base angles of the tower by numerous rivets. The main cables are painted a rich orange, and the remainder of the steelwork is coated with viridian green, a pleasing bluish-green that blends agreeably with the dark wooded expanses on both shores.

The cable anchorages are of heavily reinforced concrete, but differ in some particulars owing to conditions at each site. The one at the south end, in Stanley Park, is set deeply in a gravelly clay overburden—the top being virtually flush with the roadway. That on the opposite shore is located about 350 feet inland from the outer end of the north side span and the major bulk of it is above ground level. At each anchorage, the system by which the cable strands are secured consists principally of splayed assemblies of heavy, forged rods erected on structural frames—the entire steelwork being embedded in the mass of concrete.

From an engineering viewpoint, the piers for the main towers are especially interesting because of what had to be done in adapting each to its site. This involved unusual difficulties in the case of the south pier. The formation penetrated by the north pier, which is exposed even at normal high tide, consists of gravel, while the offshore site of the south pier is always submerged and the bedrock is sandstone generally without overburden. The area is swept by tidal currents that attain a velocity of more than 6 knots; and the maximum tidal range is 13 feet. The contractor for the substructures was Stuart Cameron & Company, Ltd., of Vancouver; and that experienced concern adopted radically different types of caissons for the two piers.

At the north-pier site, a single reinforced-concrete caisson was used. It was generally rectangular but had bluntly pointed ends, was 117 feet long and 67 feet 10 inches wide, and was divided into twelve dredging wells by transverse and longitudinal walls of reinforced concrete. Both the cutting edges of the exterior and the interior walls were strengthened with steel to make them better able to penetrate the gravel and to resist damaging abrasion. The caisson, itself, was 60 feet high when the last lift was poured; but by surmounting it with a

20.5-foot cofferdam its height was temporarily increased so that the cutting edge could penetrate to the ultimate depth of 75 feet below the original ground surface and 65 feet below the level at low tide. It was sunk by dredging the bottom material within the wells. To facilitate these operations, the gravel formation beneath the cutting edges was loosened almost daily by exploding a few sticks of dynamite in each well; and as the structure settled, its walls were heightened by successive pours of concrete. The caisson was sunk to the prescribed depth in the short span of about three months. The two pylons on which the two legs of each tower rest were poured in the dry within the cofferdam that was set on top of the caisson.

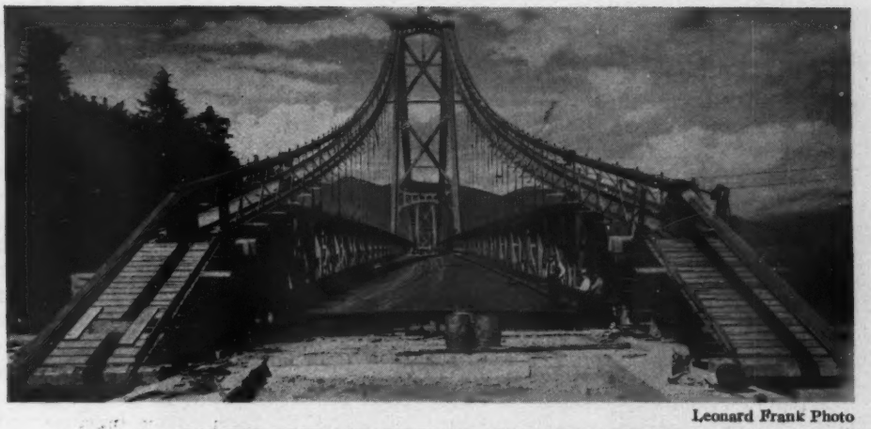
The south-pier foundation was built in two parts each of which was carried down and keyed to the submerged bedrock by means of its own cylindrical caisson having an outside diameter of 48 feet and equipped with a structural-steel cutting edge 6½ feet high. Immediately above the cutting edge was the roof of the working chamber. In the center of that chamber, and extending to the top level of the caisson, was a steel access shaft, 10 feet in diameter, that could be used either for open dredging or, if fitted with an air lock, for mucking and the passage of sand hogs and materials.

The caissons were alike. Both were constructed on shore near the pier site and floated out to their positions. While they were being built, two pits were excavated in the bedrock for their reception—one eastward and the other westward of the longitudinal axis of the bridge. W. F. Way, vice president of Stuart Cameron & Company, Ltd., has furnished the following description of the work that was done to prepare the pits for the caissons:

"The removal of the sandstone rock so as to leave open pits with practically level bottoms was the first problem to be solved. The depth of water varied from 20 to 33 feet at high tide and from 5 to 18 feet at low water. Not being able to obtain a satisfactory price for having this material drilled and shot by a local drillboat, we decided to do the work ourselves. Considerable study was given the subject in order to decide how best to do the drilling—whether to use a Jackhamer or a sinker, the size of steel, the use of Jackbits, the spacing of holes, the depth of holes, the quantities of explosives, the strength of the explosives, and the method of removing broken material.

"In the end, we decided to use S-49 Jackhamers and to drill from a float. At first, we attempted to drill the holes without using a casing and to have a diver do the loading of the holes, but that procedure did not prove satisfactory. The sandstone was soft enough to enable us to drive a pipe casing into it to a sufficient depth to hold the casing in place. By using a casing we were able to blow out the holes and to load them from the float. We used detachable bits, 2¼ inches in diameter, with side holes, as we found that end holes plugged with sludge.

"The drill float was 60 feet long and 15 feet wide, and on it we erected a framework 30 feet high which supported working levels 7½ feet apart. The holes were spaced 5 feet on centers both ways; twelve holes were drilled with each setting of the float; and they were all exploded simultaneously. Drilling started at the outboard face of the excavation, and the float was moved back parallel to the shore—that is, the shallow holes were drilled and shot first. The shallow holes were 6.5 feet deep, and the deepest holes penetrated the rock 24.5 feet. All told, 308 holes, totaling 4,103.5 feet, were drilled. We used 2,540 pounds of Giant Gelatin, 60 per cent, in 1¼-inch sticks. We removed 3,260 cubic yards of rock and used 0.8 pound of explosive per cubic yard of rock blasted. The sandstone was pulverized so fine by the shooting that it could not be handled with an orange-peel bucket, and a dipper dredge was, therefore, used. The holes shot clean to the bottom; and after the dredging was finished, a practically level floor was available that had sides that sloped about ¼ : 1. We considered the operations in every way satisfactory both as to speed of performance and cost."



Leonard Frank Photo

SOUTH END OF BRIDGE CONSTRUCTION

Showing the walkways used during the spinning of the cables and the hanging from them of the deck structure. The two main towers, one of which is shown here, are each made up of two legs formed of plates and angles and are tied together by struts and diagonals. These legs are 70 feet apart at the pier top and only 40 feet apart at the crest. The resultant taper contributes to the graceful appearance of the towers.

Courtesy, Stuart Cameron & Co., Ltd.

INSIDE A CAISSON

Workmen with CA-35 paving breakers are clearing away the central core of sandstone at the bottom of one of the two caissons for the south bridge pier. Before this was done a trench was dug all around the edge of the circular caisson and just inside the cutting edge. This was filled with concrete, thus forming a cut-off wall that is visible behind the men.

Before either caisson was sunk, the rock surface of the site and of the immediate outlying area was cleaned by divers to assure a level seating for the cutting edge and to prepare it for the pouring, by the tremie method, of a concrete seal around the cutting edge. When the latter was grounded, and while the caisson was still filled with water, divers went down in it to close any openings in the rock beneath the cutting edge with bags of sand and cement so as to prevent the concrete from flowing into the caisson. The outside seal had a vertical thickness of about 5 feet; and at intervals of 4 feet in the soft concrete were set up 2-inch pipes for grouting the deeper offshore arc of each pit. After the concrete had set, pneumatic drills served to clear out the grout pipes and to penetrate the underlying rock.

Each caisson had a total height of about 24 feet and was surmounted by a 20-foot cofferdam of timber sheeting reinforced internally. This cofferdam was unwatered when the caisson was finally seated, permitting the reinforced-concrete pier pylon, with its cut-stone facing, to be poured in the dry on top of the caisson. The east caisson was the first one to be unwatered; but a leak developed along a sand-filled seam in the rock and quickly flooded the working chamber. It was against such a contingency that the contractor had provided caissons that could either be used for open dredging or operated under air pressure. Even so, an effort was made to seal the caisson from without by a supplemental layer of tremie-poured concrete. This work involved the erection of a barricade of sand bags and large boxes filled with gravel; and when it was finished, the troublesome passage was closed and the caisson could be unwatered and kept drained.

With a caisson firmly planted, the underlying rock had to be excavated to an average depth of 3 feet below the cutting edge, and to do this it was necessary to form an annular cut-off wall in contact with the cutting edge. This wall was 4 feet high and 2 feet thick. Paving breakers were used to excavate the required trench in the sandstone, and this was filled with concrete to a point about 1 foot above the toe of the cutting edge. Both paving breakers and Jackhamers were employed to break up the remaining sandstone down to the bottom of the cut-off wall. The area so cleared served as a keyway for the massive seal of concrete that was poured within the caisson up to the top of the working chamber. Experience gained in dealing with the east caisson was of value to the engineers in getting the west one down to rock and anchored to it.

Because of the diversified nature of the substructure work, Stuart Cameron & Company, Ltd., used not only two sizes of Jackhamers but also a JA-4 Jackbit grinder, a D6U Utility hoist, a CCW woodborer, a 10DC driftbolt driver, two paving breakers, and eight clay diggers, Nos. 73 and 75. The contractor devised a 7-inch air lift that was utilized to good effect in removing sand and small pieces of broken rock from the foundation areas prior to sinking the caissons for the south pier. The air for these tools and equipment was furnished by two oil-engine-driven portable compressors, Models 210 and 315, built by the Canadian Ingersoll-Rand Company. Erection of the steelwork of the superstructure and the spinning of the suspension cables were done by the Dominion Bridge Company, Ltd., and the Hamilton Bridge Company, Ltd. In carrying forward these phases of the undertaking, compressed air was required for various purposes and largely supplied by two portable compressors of the same make.

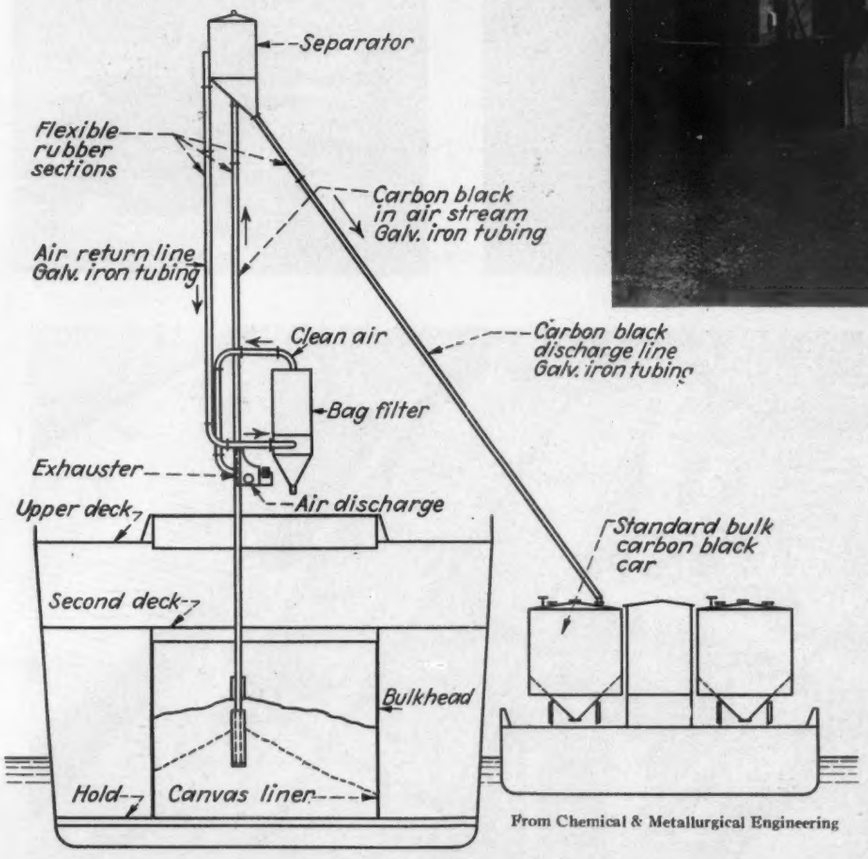
The Lions Gate Bridge was designed and its construction supervised by Monsarrat & Pratley, consulting engineers of Montreal, who furnished the author with much technical information and photographs. We are also indebted to J. Robertson, contract engineer of the Dominion Bridge Company, Ltd., and to A. J. T. Taylor, president of the First Narrows Bridge Company, Ltd., owner of the new crossing, for some of the data used in this article. Maj. W.G. Swan was the designers' Vancouver associate, and Robinson & Steinman of New York City were retained as consultants in connection with certain aspects of the project. The undertaking has involved expenditures of substantially $5,700,000. The structure has linked harbor shore lines that have a total length of 98 miles and has materially shortened the time of travel between the City of Vancouver and the north shore.

Courtesy, Stuart Cameron & Co., Ltd.

PREPARING CAISSON SITES

At the location of the south pier it was necessary to excavate pits and to level the bedrock before lowering and seating the two caissons employed there. The sandstone bottom was drilled for this purpose from a float. For each hole put down, it was necessary first to drive a casing into the sandstone through which the drilling and loading could then be done. At the left is one of the casings as it is being blown free of water with compressed air. Final clearing of the sites was done with an air lift, which removed sand and small pieces of broken rock. The picture below shows a 7-inch stream of water being discharged by this method.

First Bulk Shipment of Carbon Black by Water



From Chemical & Metallurgical Engineering

UNLOADING

At the top is the Lykes Coastwise Line freighter "Prusa" discharging the first bulk shipment of carbon black ever to be made by water. The line drawing shows the general features of the pneumatic-conveyor system and how it is installed aboard the freighter for both the loading and the unloading operations. The special wooden bulkhead that was built to receive the cargo permits all-around inspection. It is reinforced with steel and braced against the ship's hull.

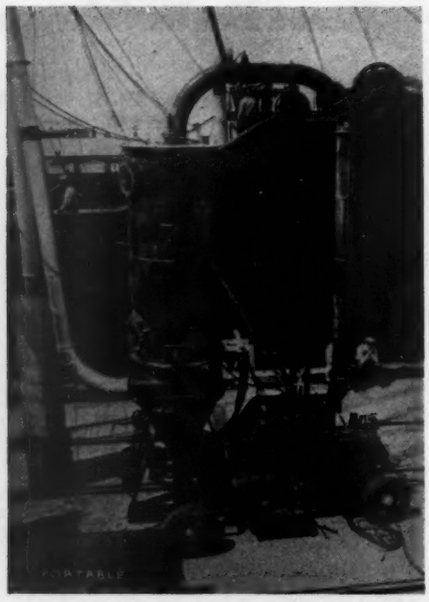
A. M. Hoffmann

HANDLING carbon black is just like handling soot, for that is what it really is. It is obtained by burning natural gas under metal plates or rolls, the average yield being 1.47 pounds per 1,000 cubic feet of gas. The material is mostly used in the manufacture of paint, ink, and rubber, the latter absorbing nearly 90 per cent of the output. In 1938, the United States consumed approximately 243,000,000 pounds and exported 167,000,000 pounds. Tank cars loaded and unloaded pneumatically serve to transport the product in bulk by rail; but not until recently has it been possible to make a bulk shipment by water that compl'es with the requirements of marine insurance underwriters, ship owners, and purchasers. They demand that the carbon black be handled and carried so that it will not contaminate other cargo, that it won't make the freighter dirty, and that it will reach its destination in a physically clean condition. For these reasons it is now the practice to pack it in paper bags.

The bulk shipment was in the nature of a test, and was made in April last by Godfrey L. Cabot, Inc., producer of Spheron, a dustless carbon black that is in the form of very fine beads. The consignment consisted of 150,000 pounds of the material, and was transported by the S. S. *Prusa* from Corpus Christi, Tex., to Boston, Mass. Loading and unloading were done by a portable pneumatic system that was developed by Cabot, Inc., and is made up mainly of a suction unit mounted on wheels, of a specially constructed nozzle, of a centrifugal separator, and of a filter or dust remover.

At Corpus Christi, the carbon black was transferred from tank cars to lower No. 1 hold of the *Prusa* with the cars standing on the dock, so that it was necessary to make adjustments as the tide rose and fell. After flowing into a large hopper, the material was drawn into the separator, which was suspended from the end of the jumbo boom and well above the hold. From there the air passed into the bag filter where it was cleaned and discharged, while the Spheron flowed by gravity directly into an especially built compartment in the fore part of the ship. This is a steel-reinforced wooden bulkhead that extends from the edges of a hatch down to the bottom of the hold. It is 26 feet long, 24 feet wide, and 17 feet high, and was sealed inside with heavy building paper to keep the cargo confined in transit. In this compartment was placed a hold liner made of canvas and treated to render it dust and waterproof. It was slightly larger in dimensions than the space occupied, and had 3-foot-diameter nipples—one at the center and one at each of the four corners—for the introduction of the delivery or suction pipes. These constituted the only openings into the bulkhead.

In the case of the initial shipment, only one line was used, and this was inserted through the central nipple. Everything operated smoothly except the equipment by means of which the carbon black col-



lected in the filter bag was conveyed to the hold. The amount of this material was very small, averaging but 1 per cent, and until adequate means for handling it could be provided it was packed in bags. It should be mentioned here that this was the only time, either during loading and unloading, that any carbon black was spilled. As a result of the delay, three days elapsed before the cargo was transferred to the *Prusa*. The maximum rate of delivery was 7,000 pounds per hour.

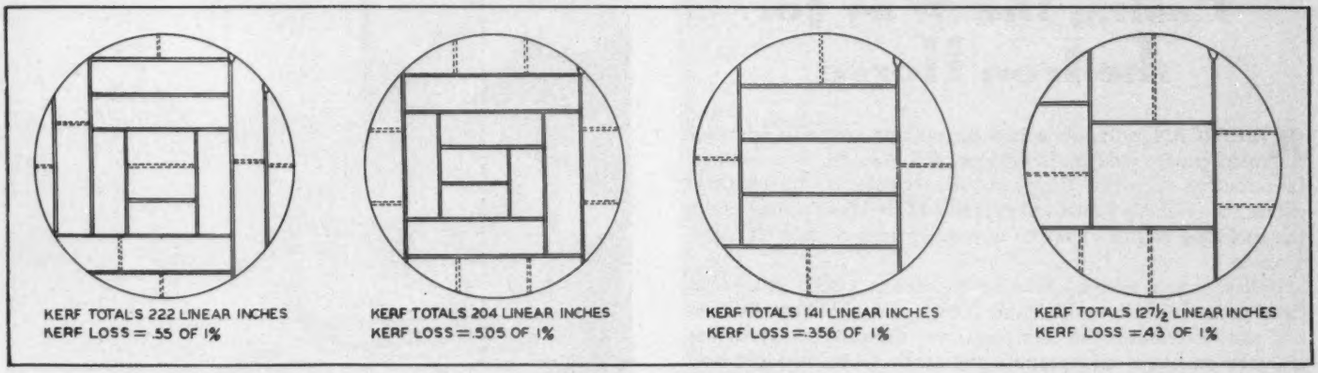
With the lading completed, the nipples were closed, the lines holding the canvas were let go, and the suction unit was hoisted on board for use in unloading at Boston. No attempt was made to trim the load in the bulkhead, which had been purposely filled only through the central opening in order to build up a pile with a nice conical top that would make it possible to determine the cargo's tendency to shift at sea. The run was an extremely smooth one, and upon opening the hold the cone was found to be as perfect as when it had been closed.

Upon arriving at Boston, the pneumatic plant was again rigged up and the Spheron transferred to tank cars on a barge moored alongside the ship so that operations were not hampered by tidal fluctuations. The single suction pipe used was inserted through the central nipple in the liner and functioned satisfactorily until it reached the bottom of the compartment, at which time more than 75 per cent of the carbon black had been withdrawn. The remainder finally had to be shoveled within range of the suction nozzle, because slight mechanical difficulties prevented shifting the latter from one to the other of the four corner nipples, as had been planned. It took 49 hours to unload, and the maximum rate of discharge was 5,600 pounds in an hour.

The other cargo carried by the *Prusa* on that trip consisted mostly of onions, with some wool and miscellaneous goods. None of these, it is claimed, bore traces of soot; and an inspection of the freighter revealed that there were no carbon-black stains visible anywhere, not even on the paper lining of the compartment in which the material had been stowed. Only the underside of the canvas was black. However, cleanliness is but one consideration. In addition, the equipment must be reliable and flexible, and convey the material at a high rate of speed at low cost. These, apparently, are not insurmountable obstacles; and the purpose of the test shipment was to bring out the weaknesses of the system. In the opinion of Cabot, Inc., it was decidedly promising, and indicated that, with a number of improvements in method and design, all the objections by consumers, ship owners, and marine insurance underwriters to water-borne bulk shipments of Spheron will be overcome. It should be added in conclusion that the method described would probably not be suitable for loose carbon black.

AT THE END OF THE RUN

The suction apparatus, top right, together with the other equipment and piping, is portable so that it can be easily handled, rigged up, and then dismounted to be available for use at either end of the run. The line leading from the left side of the cylindrical unit is the suction pipe, and directly back of it is seen the nozzle that is inserted into the bulkhead through the canvas liner, as shown at the left where preparations are underway for the discharge of the 150,000-pound shipment of Spheron. Note the cleanliness of the paper lining of the bulkhead. Immediately above are shown tank cars moored alongside the freighter. The tops of these cars are provided with numerous openings into which the discharge nozzle is successively inserted to insure a uniform distribution of the load.


KERF TOTALS 222 LINEAR INCHES
KERF LOSS = .55 OF 1%
KERF TOTALS 204 LINEAR INCHES
KERF LOSS = .505 OF 1%
KERF TOTALS 141 LINEAR INCHES
KERF LOSS = .356 OF 1%
KERF TOTALS 127½ LINEAR INCHES
KERF LOSS = .43 OF 1%

VARIOUS LOG CUTS

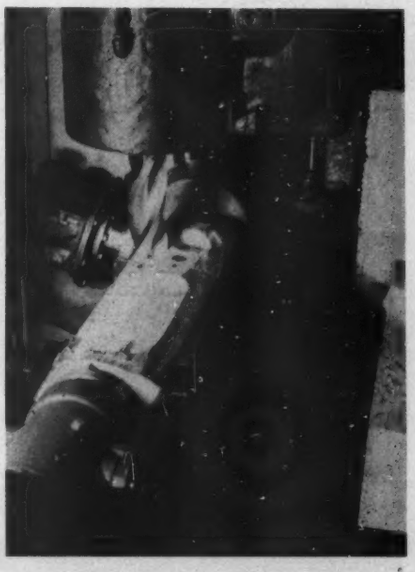
These sketches show four different patterns in which a log of 30-inch diameter can be sawed. From left to right, respectively, the resultant cants are 2, 4, 6, and 8 inches thick. Headsaw cuts are indicated in solid lines, and rip-saw cuts in broken lines. The kerf, or width of the head-saw cut, is figured to be 0.17 inch and that of the rip saw 0.235 inch.

Special Machines Remove Defects from Pulpwood

THE first step in the making of wood pulp is the reduction of logs to chips. It is desirable, of course, that these chips be free from defective wood. At the same time, in the interest of economy and conservation, mills strive to obtain as great a quantity of clean chips as possible from every 1,000 feet of logs.

In the northwestern part of the United States, economic conditions have made it feasible to break down whole logs into sections or cants to expose the inclusions of rot, conky wood, ingrown seams, and black knots. These can then be removed with a minimum of waste of good wood. The thickness of the cants varies in accordance with the number and nature of the defects, but usually is 4, 6, or 8 inches, and may reach 11 inches.

Many ingenious machines have been developed for the purpose of freeing these cants of defects; and one of the specialists in this field is the Stetson-Ross Machine Company of Seattle, Wash. Barking machines are generally arranged to handle long cants—those ranging from 8 to 20 feet in length and having cross sections of from 2x4 to 11x17 inches. Other defect-removing machines have been designed for either long or short pieces, depending upon the demands of the different mills. Compressed air has been found to be well suited for performing some of the operations required of these machines; and several of them embody air motors, as described in the caption accompanying the photographic reproductions shown at the right and below.



BARKER AND BROUTER

The picture at the left shows a section of a cant barker and a length of flat log, approximately 16 inches wide and 8 inches thick, with its outer or bark-covered surface presented to a concave cutterhead. At the top center is an electric motor that slues or turns the concave knife of the cutterhead and adjusts it according to the size of the log. In the center, at the right-hand edge, is an I-R air motor that tilts the cutterhead assembly the required degree. On the opposite side of the machine is a similar air motor that raises and lowers the cutterhead assembly to a height sufficient to accommodate the cant being barked.

Above is illustrated the essential part of a "brouter," which is so named because it bores and routs. The cants are conveyed to the brouter, clamped between air chucks, and presented to the cutter. The air motor at the left of the tool rotates the block of wood so that all sides of it may be worked on in turn. The bit is electric driven, and can be moved either vertically or horizontally.

Easing the Way for the Iron Horse

AMERICAN railroads spend huge sums annually on track maintenance and improvement. Reballasting is an important routine operation that every line carries on to whatever extent its available funds will permit. More labor is devoted to the surfacing of track than to any other item of railroad maintenance.

Ballast is to a railroad what springs are to a bed. A layer of clean stone beneath and between ties forms a resilient foundation that distributes the train load over the subgrade, provides effective drainage, and permits the track to be surfaced and lined without disturbing the roadbed. After ballast has been in place for a time, the spaces between individual pieces of stone become filled up with dirt, coal dust, and cinders, and it becomes necessary to remove the ballast, clean it, and replace it. The operation includes raising, grading, and lining the track and adding stone to improve the roadbed.

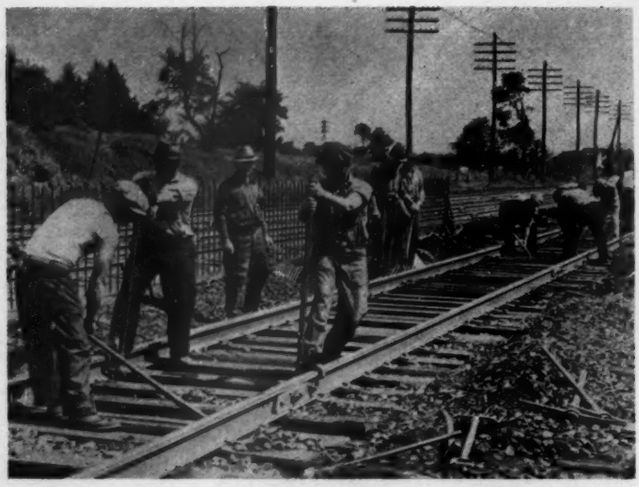
Every progressive railroad now uses air-operated tie tampers to work the stone under the ties quickly and effectively. This was formerly done entirely with hand-wielded picks, forks, and tamping bars. The operations were not only slow and laborious but also of doubtful value. A few stones could be worked under each tie, but it was difficult to form a substantial, well-distributed base for the track structure. It has been well established that one man with a power tamper can accomplish as much as four to eight hand workers. Each pneumatic tamper consumes only from 12 to 15 cubic feet of air at 80 pounds pressure per minute. The fact is that few railroads, with their necessarily restricted budgets, could at present maintain their tracks in satisfactory condition without power equipment.

The need of keeping tracks in good condition is more pronounced now than ever before because of the higher speeds that are in force. As one railroad man has expressed it, "Faster trains require faster tracks, better materials, stronger construction, more exacting maintenance."

This series of pictures shows the sequence of reballasting operations on the New York, New Haven & Hartford Railroad. The working crew consists of 290 men, the total labor cost being about $1,500 a day. They leave camp at six o'clock in the morning, pause half an hour for lunch at two, and are finished at 2:30. They can reballast from 2,000 to 3,000 feet of single-track line in a day.

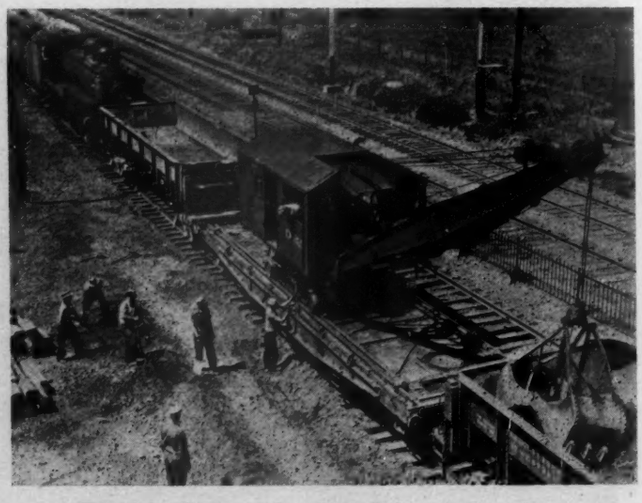
Photographs by Hiland D. Holt

1—One of the road's new "1400" stackless steam locomotives passing the camp in which the ballasting gang lives. The smoke is drawn backward through a passage on top of the locomotive.

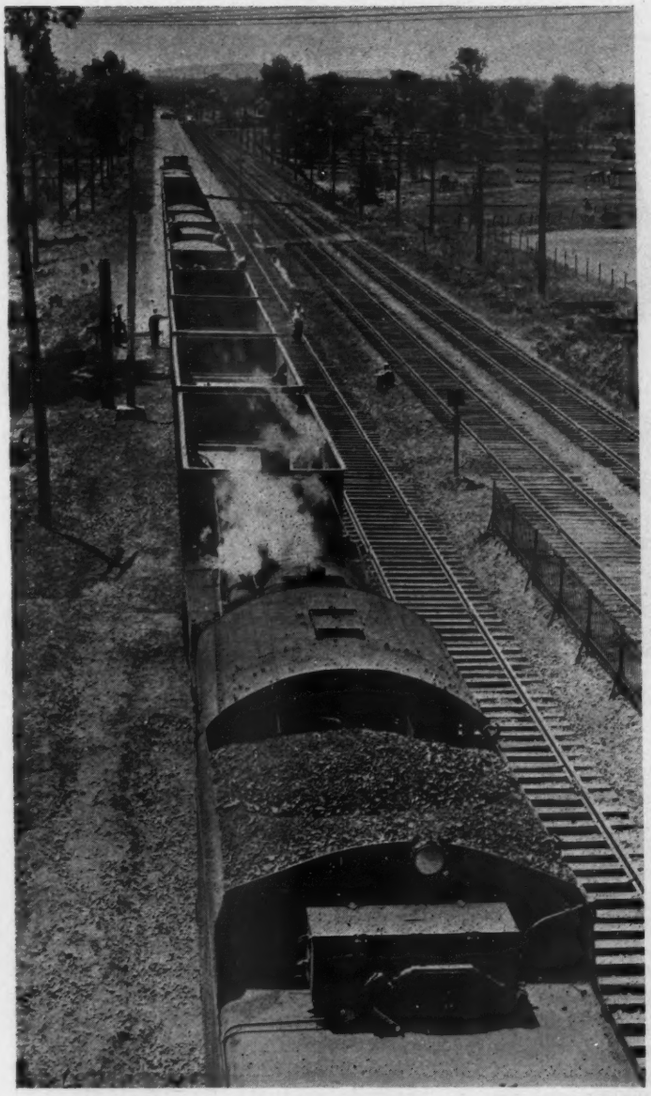


2—Cribbing out and skeletonizing track. The men at the right are removing old ballast from between ties. Those at the left are truing up ties and respacing them an equal distance apart.

3—Using Ingersoll-Rand pneumatic cribbing forks to loosen ballast. Notice the dirt—mostly cinders from locomotives and coal dropped from passing cars. It holds water and prevents proper drainage.



4—Digging ditch at the side of the track to improve drainage. The crane is mounted on tracks laid on top of a flat car to permit it to move back and forth. Old ballast that is dug up is reclaimed.



5—The stone train. Old ballast is mechanically cleaned and then re-used. Additional stone (approximately 2 inches in greatest dimension) is hauled in. Note the skeletonized track at the right of the train.

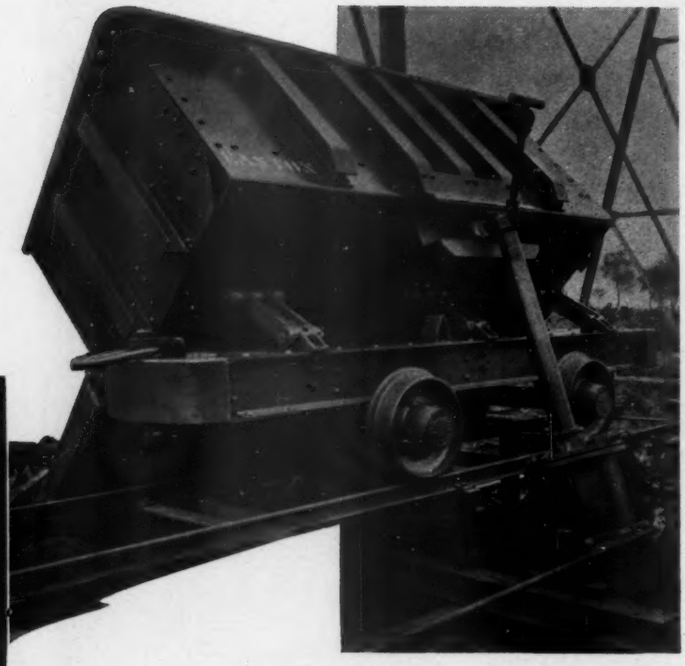
7—Tamping. A 12-man gang, using I-R pneumatic tampers, works the ballast underneath the ties to form a firm, resilient roadbed. The supply of operating air comes from a compressor, at the right.

8—Dressing track. The shoulders are built up to a uniform width, and an even outside line is established. Note the whistle hanging from the foreman's shirt. It warns the workers of approaching trains.

6—Raising track. Engineers set grade stakes on either side, and the straightedge rests on them. A Nordberg track jack lifts rails and ties, and surplus ballast falls into the cribs between the ties.

9—Highballing. An express train bound for New York gathers speed on a newly ballasted section of line. Veteran engineers know without looking when they are running on reconditioned track.

Dumping Cars or Trucks by Air Power



AIR-DUMP MECHANISMS

The picture above shows a car being dumped by direct lift exerted by the plunger of an air hoist. This type of equipment can be used only when the body moves through an arc of not more than 45°. At the left is a set-up for a truck or semitrailer bodies arranged for remote-control dumping. The hoist applies its power through a wire rope with a hook that engages a bar on the side of the container body. The latter is built so that it can be dumped from either side.

AMONG the various power dumping mechanisms applied to cars and trucks are several that are operated by compressed air. We are referring here to stationary installations at fixed dumping points. Their use makes it unnecessary to equip each carrier with a dumping device, thereby effecting substantial savings. Apparatus of this kind can be operated by steam or electricity as well as by air, the type selected usually depending upon the power available at the dumping point. Many plants such as cement mills and quarries producing crushed stone have chosen air-operated dumping mechanisms at their crushers because compressors are already set up to supply air for rock drills and for other services.

The accompanying illustrations show two types of air dumping appliances that are furnished by the Easton Car & Construction Company for use with its line of Phoenix quarry cars and semitrailer bodies and also with similar equipment made by other concerns. One of them consists of an air cylinder and piston that tips the body by direct contact of the plunger with its side. The cylinder is stationed at the dumping point beside the track or roadway, and the car or truck is stopped so that the body is in the correct position where the plunger can rise up against it when the air is turned on. This type can be used only when the container dumps through an angle of 45° or less.

For service where the container dumps through an angle of 90°, a different set-up has been developed. This consists of an air cylinder with a wire rope connected to the end of the plunger and running over one or more sheave wheels. At the other end of the rope is a hook of special design that engages a bar at the side of the truck body. At the beginning of the dumping operation the plunger of the air cylinder is extended the full length of its stroke. When power is applied, it retracts, pulling the rope with it and lifting the side of the container to which the hook is secured. When empty, the body returns to its normal position through its own weight, being lowered gradually by the cylinder hookup.

A dumping mechanism of this sort can be remotely controlled, and requires only one man to work and to supervise it. Where such a set-up is employed at a crusher, the operator stands where he can observe the dumping to advantage and controls the hoist from that point. As a man is regularly stationed at the crusher, the dumping mechanism entails no additional labor cost.

It will be apparent that, as the body of a container tips, virtually all its weight and that of the load is shifted to one side, thereby delivering a heavy shock to the tires of automotive equipment. To prevent this, Phoenix semitrailer frames may be had equipped with patented outrigger feet which bear upon a concrete wall while the load is being dumped. These feet can be raised or lowered to the desired height by means of shims.

Marks painted upon the side of a wall enable drivers to stop their cars in the exact spot for dumping. The hook on the end of the dumping rope is ordinarily held back out of the way by a hinged arm. As power is applied to the cylinder, the hook moves toward the body and engages the lifting bar automatically. It is held there during lifting and lowering by a spring device built into it. When the body has been restored to its normal position, and there is no longer any load on the hook, the latter is automatically released.

The advantage of a dumping mechanism of this character is that it speeds up haulage of the material. Tests have shown that it is possible to dump a load in from 6 to 10 seconds. The air cylinders employed vary with the size of the haulage equipment; and Phoenix bodies range in capacity from 3 to 12 cubic yards. The cylinder used with the Model RP-10, which carries a pay load of 15 to 20 tons, has a diameter of 17 inches and a piston stroke of 9 feet. It exerts a pull of 20,000 pounds. The maximum rope speed is 100 feet a minute. For installations of the kind described, air at 80 pounds pressure per square inch is commonly specified. The manufacturer states that 10 cubic feet of air will lift the maximum load one foot.

VITAL WAR MATERIALS

THE trend of the European conflict thus far indicates that it is to be as much an economic as a military war. It is clearly manifest that the Allies intend to conserve human life so far as possible, and to wage a conflict of attrition. In adopting this form of strategy they are profiting by the lessons learned in the last great war, in which victory came not so much from superiority of arms as from greater economic endurance. For the present, at least, it would seem that this course is more certain of ultimate success than any other that could be chosen, and there is no question that, if it can be pursued, it will keep casualties and property destruction at a minimum. The plan obviously presages a long war, but one that will drain the man power of all nations involved to a relatively small extent.

Conditions, as they now exist, are much more favorable for a war along these lines than they were in 1914. At that time, France and Belgium were invaded, and to repulse the enemy it was necessary to throw men into the breach without counting the toll of human lives. In contrast, the Maginot line now promises protection of French soil and affords shelter from which troops need emerge only in small numbers for localized offensives. The brunt of the attack is borne by tanks, airplanes, and artillery, and the intention seems to be to be content with small advances, or even with preventing the enemy from launching an effective offensive. Meanwhile, it is believed that England can retain her supremacy on the seas and keep a steady stream of supplies flowing to the Allies while preventing any water-borne shipments from reaching Germany. If these conditions can be maintained, Germany's ability to carry on will depend solely on how much of her vital materials she can produce within her own borders and how much she can obtain from Russia, the Balkan nations, and Italy.

Germany normally imports one-fifth of her foodstuffs, being self-sufficient only in sugar and potatoes. Of industrial materials, she has plentiful supplies of only coal, potash, and magnesite. She can partly fill her needs of oil, iron ore, lead, zinc, manganese, antimony, timber, sulphur, and rubber. She is almost totally deficient in copper, nickel, tungsten, molybdenum, tin, chromium, vanadium, mercury, bauxite, asbestos, phosphates, cotton, wool, flax, silk, jute, hemp, and sisal.

The ability of Germany to purchase these materials is questionable. She has no gold and no credits abroad, and must depend upon paying in kind—that is, upon barter. Since the Allies have ample funds and credits, some of the supplying nations might prefer to deal with them. Even if they do trade chiefly with Germany, their resources are not sufficient to meet her requirements. A lot will no doubt depend upon how much help Russia is willing to give. Admittedly, if she opens her granaries, oil fields, and mines to Germany, the war will be prolonged, but many authorities hold that the end will inevitably be the same as it was in 1918.

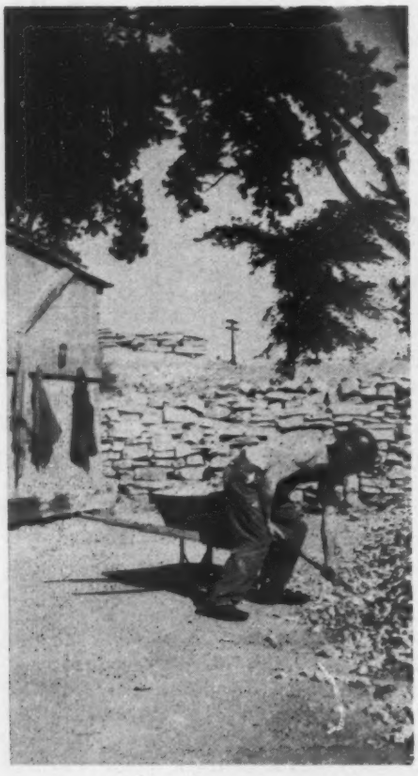
There is, of course, the possibility that German chemists and engineers will be able to meet some of the deficiencies with synthetic materials and substitutes. It will be recalled that during the last war, with nitrates from Chile cut off, adequate quantities of nitrogen for making explosives were extracted from the atmosphere by the Haber process. Buna, an artificial rubber, is now being made from coal and limestone, and gasoline hydrogenated from coal supplies about one-third of Germany's peacetime consumption. In nearly every case, however, these synthetized products cost more than the natural ones which they replace. Moreover, their manufacture on a large scale would require the extensive use of men and machinery, thereby lessening the resources available for waging war and producing armament.

Oil is conceded to be one of the most essential materials for carrying on modern warfare; and its scarcity in Germany and its abundance among the Allies unquestionably played a major part in determining the outcome of the World War. Similarly, the experts believe it will again swing the balance of power to the Allies. Writing in the *New York Times*, Waldemar Kaempffert predicts that even if Germany obtains oil from Rumania and Russia the supply will not meet the demand. Leaving out the requirements of naval vessels, he states that if Germany is to keep her military and industrial machinery running in high gear her minimum annual need of oil will be 20,000,000 metric tons. Against this, he estimates her own output, plus that from Poland and Czecho-Slovakia, at 800,000 metric tons. If there is added to this the 2,000,000 tons of synthetic motor oils that Germany produces, the 6,600,000 tons that might become available if Rumania were brought under German domination, and the exportable surplus of 1,000,000 tons that Russia could offer, the total of 10,400,000 tons would still be only about half of her requirement. The remainder, if it is obtained, must come from Russian crude oil and from an increase in the synthetic production at home.

But the Russian oil fields are located at a considerable distance from Germany; and, with the poor transportation facilities between them, it would be difficult to supply the deficiency. Also, there are obstacles in the way of increasing the domestic synthetic output. Between 4 and 5 tons of coal are required for each ton of gasoline, and a great many men would be needed to mine it, aside from the large forces that would have to run the extraction plants. Moreover, fuel made in this manner costs, roughly, four times as much as that obtained from petroleum.

It is not known, of course, how large a quantity of oil Germany had in reserve at the beginning of the war; but records of her imports for several years indicate that the quantity could not have been a large one. As her invasion of Poland was largely a mechanized march, great amounts of oil were undoubtedly consumed. As for the Allies, they are much better situated with regard to sources of supply; and if they are permitted to obtain oil from the United States, there is no question that their needs will be fully satisfied.

Introducing the "Muck Stick" into Manchukuo



WITH NEW TOOLS

At the left, a Japanese mucker assumes the correct stance. Above, he practices the art of piloting a wheelbarrow around a corner.

FROM the obscure hills of faraway Manchukuo comes a story of Yankee ingenuity. There, prospectors have uncovered mineral deposits of great value, the metal obtained being chrome-nickel which is now sought and mined with feverish haste to supply the needs of war-material manufacturers.

Following the custom established by other foreign powers of employing skilled American engineers to plan and direct mining operations, Japan likewise availed herself of American mining men. However, the engineer in charge of that newly developed property found that he was severely handicapped by unskilled native labor and inefficient machinery and tools. Robust and energetic as the wiry little miners are, still they could not shovel ore in sufficient quantities to meet the approval of their new chief; for down through the ages the Japanese miner or mucker had consistently used only two tools to load broken ore. These, known as the *kassa* and the *mi*, had always served him well, and therefore he saw no reason for a change.

The *mi* is a 3-cornered blade, not unlike our garden hoe, fastened to a wooden shaft. It is used to pull and scrape the ore forward on to a tool, resembling our dust pan, that is equipped with two handles, one on each side. This is the *kassa*. The filled pan is lifted rather awkwardly, and the load deposited in a basket, which is later carried away by either one or two men, depending on the size of the basket and the weight of its contents.

The engineer's request to local mine supply houses for more satisfactory equipment resulted in a consignment of crude square shovels. These his miners at once rejected as being no better than their time-honored *kassa* and *mi*. Baffled for a moment, the engineer arranged for a shipment, via the *China Clipper*, of standard American No.2 pointed steel shovels, with the popular D-shaped grip at the end of the handle. This shovel is referred to by all American miners as a "muck stick," and upon its arrival was used as a pattern by a Japanese manufacturer.

The first dozen of the new shovels was designated for a unique school—a muckers' school. The management had reproduced, on the surface, a mine complete with timbers, sheet-steel-covered floor, ore piles, wheelbarrows, etc. Twelve likely miners were then given intensive training under the tutelage of the engineer, who demonstrated by actions and through an interpreter, first, how to stand in order to force the shovel forward along the steel floor and into the ore, then how to lift it easily and gracefully, and also how to avoid barking knuckles on the supporting timbers. The course likewise involved the making of short turns in a model drift with a loaded wheelbarrow; and the men were taught to stand aside with their barrows to allow loaded ones to pass.

As these students became experienced, others took their places. Later, several top-notch men were selected, after weeks of actual work underground, to enact the various operations for a motion-picture film. This is now being shown in other districts of Japan; but the school will soon have to close for lack of pupils.

Thus the "muck stick" made good and caused another ancient Japanese practice to succumb to modern American procedure.

Salt a Factor in the Production of Petroleum

SALT, we are told upon good authority, presents a twofold problem in the production of petroleum. If an excessive quantity of brine is present in a field, the question is how to dispose of it; and if there is a lack of salt in wells, the chances are that they will become clogged and possibly cease to flow. According to the U. S. Bureau of Mines, the practice is to let the oil-field brines and the salt water trapped in crude oil run to waste for want of a commercially practicable method of dealing with them. Attempts have been made to recover the salt, but so far without success. Five or more years ago, one oil company built a plant for this purpose, but abandoned it when it was discovered that the cost of purifying the salt—removing the oily taste for table or other uses—was prohibitive.

The salt content of the oils in one of our large fields ranges anywhere from 40 to 3,500 pounds per 1,000 barrels, not including the salt in the water produced with the oil. Large as this proportion is, statistics reveal that it is on the increase, a condition that the Bureau of Mines attributes to a number of factors, namely—"the acid-treatment of wells; development of new fields producing oils of greater salt content; and the depletion of old fields, with an attendant increase in the production of emulsified brine."

In a paper recently presented before the American Geophysical Union by David G. Thompson, senior geologist of the U. S. Geological Survey, it was pointed out that the problems involved are of a chemical, hydrological, and geological nature and have been engaging the attention of the Bureau of Mines for some time. The results of its latest investigations have been published in a report (3434), entitled *Typical Oil Field Brine Conditioning Systems*, which deals with seven such systems.

However, the wells that are devoid of brine may prove to be an outlet for some of the salt from fields in which there is an excess. As described by F. R. Cozzens in the February, 1939, issue of this magazine, an absence of salt water in wells causes the paraffin in the oil to harden, with the result that production drops, if the flow does not stop altogether. Experience has proved that active wells of this kind can be made to yield more and abandoned wells actually made productive again by the introduction of salt water with air under pressure.

Safeguarding Bomb Shelters with Compressed Air

ONE of the paramount considerations arising in Europe as a result of the war that threatens to be of long duration is the problem of providing adequate gas-proof shelters for both civilians and soldiers. Based on a trend that was manifesting itself during the closing months of the last conflict, it seems likely that compressed air will be used as a protective medium. Writing in the London publication *Compressed Air Engineering*, J. W. Fidoe, an ex-staff captain in the British forces, discusses the problem in the light of his experience as a member of a committee named in 1918 to devise more satisfactory methods of dugout protection. At that time there were heavy casualties from gas; and considerable research was done to develop systems for filtering outside air and circulating it throughout the shelters.

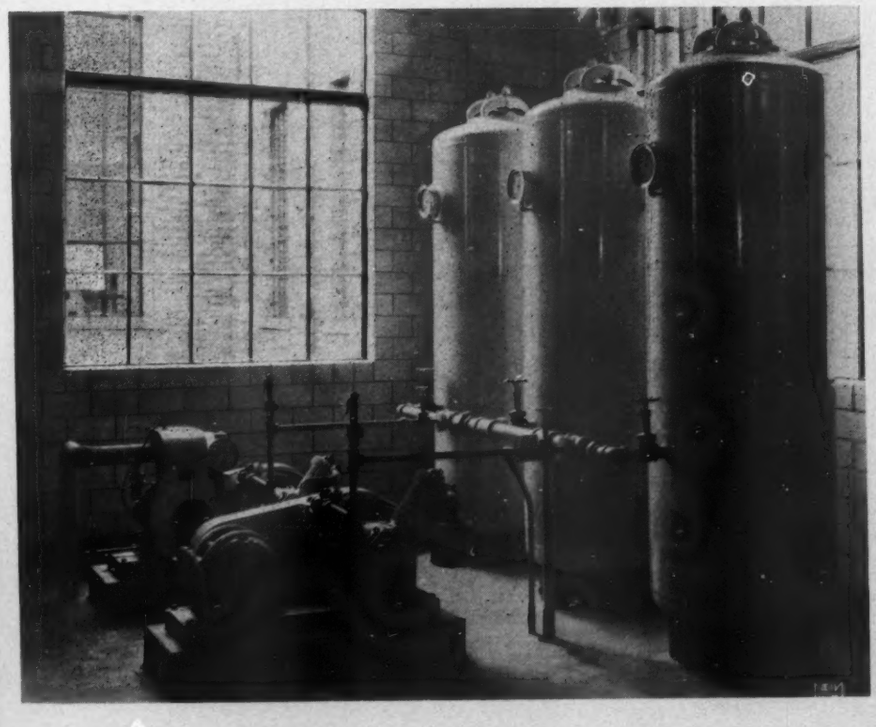
It was found that in sizable dugouts, requiring large volumes of air, the various resistances to the air flow were such as to affect the capacity of fans. Reciprocating compressors, on the other hand, were not so affected, as their output is proportional to their speed so long as there is no change in the air resistance at the intake. The resistances referred to were those encountered in the duct leading to the filter, in the filter itself, in the fan or compressor, and the resistance to the flow of the clean air through the shelter. The one last mentioned proved to be highly variable. With only a few persons in a shelter, the air friction is low; but when the enclosure is fully occupied, the space in any section of it is reduced, air velocity tends to increase, friction increases with the square of the velocity, and a centrifugal fan is affected according to the nature of its characteristic curve.

Experience has shown that every underground shelter should have at least two entrances, spaced as far apart as possible to lessen the likelihood of both being blown in during an attack. The air inlet to the filter and compressor should be placed elsewhere than at an entrance; the filtration equipment should either be located underground or fully protected from a direct hit by a bomb or shell; and the air intake should be as far above the surface of the ground as conditions will permit. The entrances form outlets for the air current circulating in the shelter, and each should face an open space providing for approach from several directions. Where dugouts are of considerable size, it is advisable to have more than one air inlet. It is advantageous to divide large shelters into compartments, each with its own filtration equipment and with the chambers interconnected by air locks so that one can be opened into another as a temporary emergency measure.

The best filtering medium is charcoal that has been prepared for the purpose, as it has the power of adsorbing gases. During the last war it was found that charcoal from cocoanut shells has a much greater power of adsorption per unit of volume than has that from light woods. The density of activated charcoal made from cocoanut shells is such that one gram of it has around 2,990 square yards of surface.

Electric Eye in the Photographic Field

THERE seems to be no end to the amazing things that can be done through the medium of the photo-electric cell or electric eye, as it is popularly known. A recent unusual application has been made of it in the photographic field where it serves to control the operation of an air brush used in enlarging or reproducing photographs, prints, or drawings on well-nigh any material—linen, paper, thin sheets of metal, etc.—of any size that will wrap around a drum. The process involves scanning of a photograph or drawing by a beam of light from an Osram exciter lamp so that the reflected beam will vary in intensity in accordance with the lights and shades in the picture. As it changes, the light is converted by means of the photo-electric cell into current that changes correspondingly. This current is passed through a valve amplifier and serves to actuate a spray gun, the jet delivered being in proportion to the impulse received. The resultant reproduction, except for the fact that the pigment composing the image is deposited electrically instead of chemically, does not differ from a photograph produced by the carbon process.



ARTISTIC COMPRESSOR INSTALLATION

Here is proof that machinery can be made attractive in appearance. The picture shows two Type 30 air compressors and three receivers installed in the Ohio Sewage Treatment Plant in Columbus, Ohio. The air is used for starting Rathbun-Jones oil engines. One compressor is driven by a gasoline engine: the other by a motor.

Phone Generates Power

A TELEPHONE instrument that obtains its power from the voice of the speaker—that requires no outside electric current—has been announced by the Western Electric Company. It has been designed primarily for service on shipboard so that telephonic communication can be maintained in case of failure of the electric supply system. It is said to be absolutely reliable, and enables the user to summon any one of five stations.

Six instruments can be connected in a network. Calls can be made between any two of these telephones, or all can be hooked up for a 6-sided conversation. A self-contained, hand-operated generator serves for signaling the different stations, and the current for the instruments is generated internally by the impact on diaphragms of the sound waves set up by the voices. While intended only for short-range communication, the 11A Magnetic Telephone, as it is known, has been effective over a 200-mile-long test line of No. 9 copper wire. Because of its watertight and weather-resistant construction, it is also suitable for camp use, factories, etc.

Industrial Notes

During the processing of ripe olives, the fruit is exposed to the air or placed in water through which compressed air is bubbled. The object in either case is to darken the color of the olives by oxidation.

Tunneling operations with an entirely new object in view are in progress beneath Ramsgate General Hospital, Ramsgate, England. Out of the rock chalk 90 feet underground there is being carved an addition to the hospital, complete in every respect and including a ward 559 feet long for the accommodation of 200 beds.

By lining forms with rough Celotex fiberboard coated with a thin film of boiled linseed oil, concrete can be given a surface that is said to be not only pleasing in appearance but that also reduces glare and is not subject to crazing. The interior and exterior walls of the new railroad terminal in Los Angeles, Calif., have for the most part been treated in this manner.

Among the new equipment announced by Ingersoll-Rand Company are two high-production hot-milling machines for reconditioning its detachable rock-drill bits known as Jackbits. Aptly named Jackmills, the Size JMA has a capacity of 110 to 180 bits of 3½ maximum gauge an hour and the JMB has a capacity of 75 to 90 bits of 2⅝ maximum gauge an hour. Both are driven by electric motor, and the JMA has an air-operated feed mechanism. Each is provided with a standard cutter that both sharpens and gauges all conventional 4-point bits; but interchange with 6-point and Carr-bit cutters can be easily effected. According to the manufacturer, the cutters can be resharpened a number of times, thus giving them a long service life. The 10-inch-diameter cutter of the large Jackmill will recondition from 40,000 to 60,000 bits before it needs resharpening, while the smaller JMB cutter will redress from 15,000 to 30,000. All reconditioned bits are of uniform size and shape and, because of a slight flow of metal during the milling operation, hold their gauge longer when drilling than they otherwise would, thus increasing their life from 30 to 50 per cent. Details about these machines are contained in an illustrated folder, No. 2579, which can be obtained by addressing the company's main office, 11 Broadway, New York, N. Y., or any of its branches.

JACKMILL AND ACCESSORIES

The Size JMA hot-milling machine, the 4-point bit cutters for the two Jackmills, and an I-R Jackbit quenching fixture. The latter distributes the right amount of water to the faces of each bit and also circulates it rapidly, thus preventing soft spots and hardening the bits uniformly to the prescribed depth.

Rockwood Manufacturing Company has announced a new booklet dealing with its full line of pivoted bases for electric motors and gas engines. This type of short-center drive was developed by Rockwood, and by means of it the belt is automatically tightened whenever the load increases. The bulletin, No. 861, is profusely illustrated, and the information contained in it is based on the company's experience with a wide range of installations totaling more than 1,000,000 hp. It includes several pages devoted to the mechanics of pivoted drives and to the basic principles upon which they operate, as well as tables which enable prospective users to select the base required for a motor of given dimensions and rating. Copies of the booklet can be obtained from the company at 1801-2001 English Avenue, Indianapolis, Ind.

Something far simpler than geophysical prospecting for the discovery of mineral deposits is advocated by two Swedish scientists. They claim that if mineral is present in the earth, the water in the earth will bear traces of it and that those traces will vary in degree with the mineral's density and solubility. Provided the region is not an arid one, trees and shrubs will suck up this mineral-bearing solution and store the metal in their leaves. When these are examined by laboratory methods they will reveal whether or not there are minerals in the area in which they grew. It is said that experiments so far made with the new method of prospecting have been successful.

New Jersey Meter Company, Plainfield, N. J., announces a new size DriAir separator suitable for use in connection with small air lines or branches having a diameter of ¾ inch and less. It embodies all the distinctive features of the larger sizes—noncollapsible self-bailing float, valve and float mechanism mounted on a side plate so that it can be removed in its entirety without disturbing the piping, a water-sealed valve to prevent air leakage, etc. It separates and automatically ejects the water and oil condensed in the line and collects the dirt, rust, or other foreign matter entrained in the air, thus preventing it from reaching pneumatic tools and equipment and causing trouble. With a ¾-inch inlet and outlet and air at 80 pounds pressure and more it has a capacity of 50 cfm. The two other standard sizes have capacities, respectively, of 100 and 300 cfm. at 80 pounds pressure, or proportionately lower capacities at lower pressures. At any pressure within the prescribed limits, says the manufacturer, each unit can effectually handle the volume of air that a pipe line corresponding in size to the DriAir inlet and outlet connections should carry. The separators are compact and easy to install, either hanging from overhead piping or standing on the floor.

At the recent annual convention of the New York State Association of Milk and Dairy Inspectors, the delegates were given samples of milk from which the air had been withdrawn. Why, the consumer will ask, deaerate milk? The scientists tell us that it results in a more concentrated and therefore a more nutritious foodstuff, while those that tasted it were of the opinion that it had a better flavor than ordinary milk. As the air is much lighter than the liquid, it is easily extracted by pulling a vacuum on the milk. Whether or not the process will be put to practical use remains to be seen.

It is reported from abroad that the time required for decoppering waste liquor by the cementation process has been greatly reduced by improved methods introduced in Germany. By placing finely divided iron scrap in the liquid to be treated, and by bringing the latter in intimate contact with the iron by means of a mixing device, precipitation is effected in one minute as compared with 24 hours by the usual procedure.